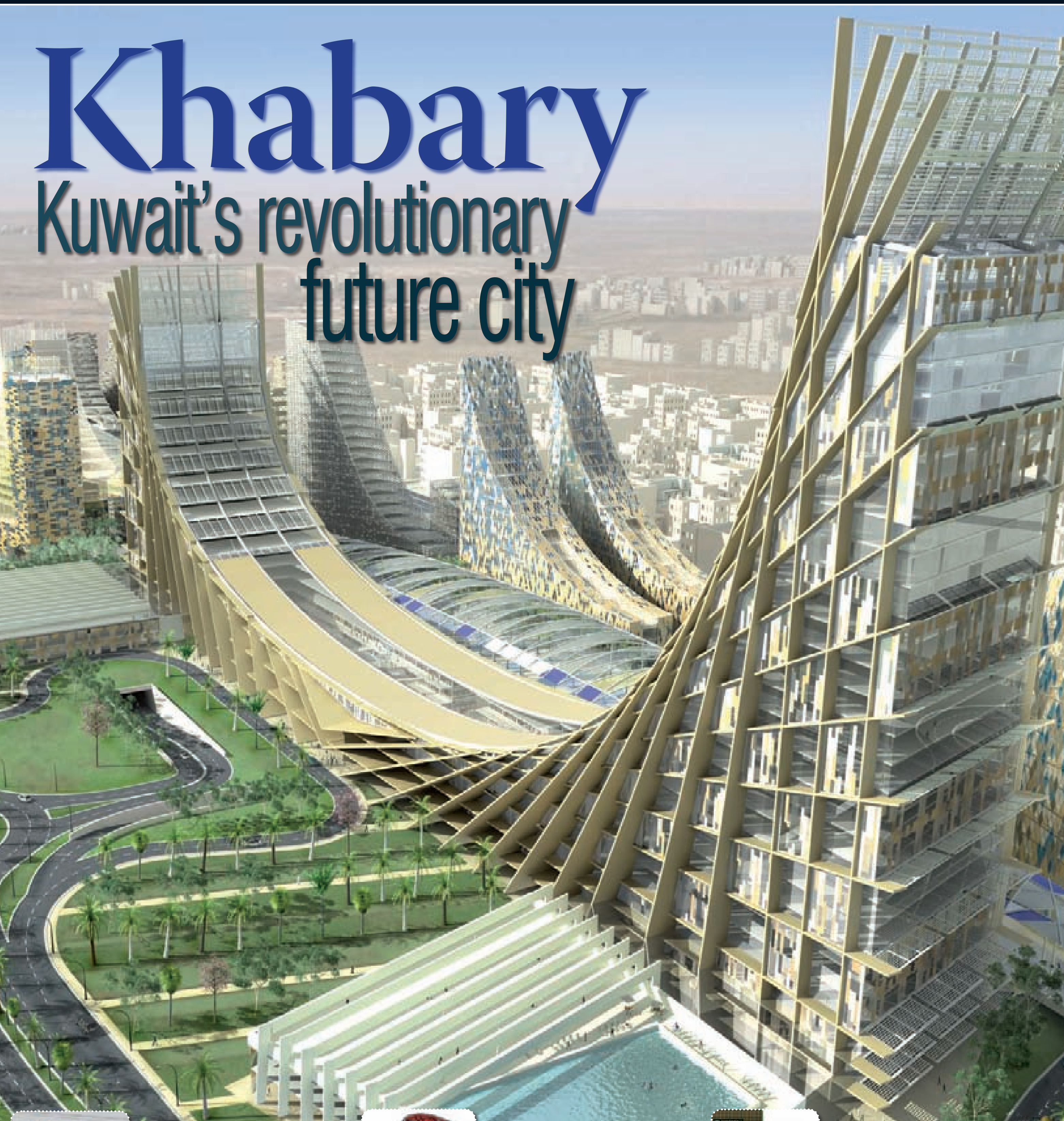
July/August 2006 >> Vol.26

AECMAGAZINE

DESIGN, MANAGEMENT & COLLABORATION IN THE BUILT ENVIRONMENT



Khabary

Kuwait's revolutionary future city



V8 XM – a 3D evolution for Bentley's MicroStation



Revit Structure 3 – a new era in structural engineering



Intel Xeon 5100 series – the fastest CPU in the world

AEC MAGAZINE
DESIGN, MANAGEMENT & COLLABORATION IN THE BUILT ENVIRONMENT

Editorial

Publishing Director: Martyn Day
Email: martyn@edaltd.co.uk

Managing Editor: Greg Corke
Email: greg@edaltd.co.uk

MCAD Technical Editor: Alistar Lloyd Dean
Email: al@edaltd.co.uk

Consulting Editor: John Marchant
Email: john.marchant@skilstream.com

Publisher: Geoff Walker
Email: geoff@edaltd.co.uk

Design and Production

Dave Oswald
Email: dave@edaltd.co.uk

Advertising

Group Advertising Manager: Peter Jones
Email: peter@edaltd.co.uk

Deputy Advertising Manager: Steve Banks
Email: steve@edaltd.co.uk

Accounts Director: Terry Wright
Email: terry@edaltd.co.uk

Subscriptions

Database Manager: Alan Cleveland
Email: alan@edaltd.co.uk

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EDA Ltd. 63-66 Hatton Garden, London EC1N 8SR
Tel: +44 (0) 20 7681 1000
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www.designhive.co.uk

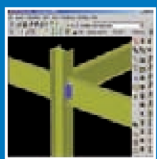
ATI and AMD to form processing powerhouse



AMD and ATI are set to merge in a deal worth $5.4bn. As part of the announcement last month AMD acknowledged its long term objective is to create a unified platform using a mixture of its CPUs (Central processing Units), ATI's GPUs (Graphics Processing Units) and ATI's motherboard chipsets, using different combinations depending on the target market.

www.amd.com / www.ati.com

Bentley updates RAM Advanse for structures



Bentley has followed up its acquisition of RAM International last December with the launch of RAM Advanse Version 8.0, the latest release of the finite element analysis and design software system. RAM Advanse provides advanced design features for hot-rolled steel, cold-formed steel, wood and concrete, and can be used to design most types of structures. The new release includes new modules for the design of specialist wall types, plus support for BS 8110-1: 1997.

www.bentley.com/structural

Dell to recall 4.1 million notebook batteries

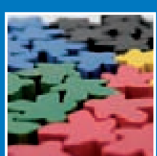


Dell is to recall approximately 4.1 million Dell-branded lithium-ion batteries with cells manufactured by Sony. Under rare conditions, it is possible for these batteries to overheat, which could cause a risk of fire.

The recalled batteries were shipped in certain Dell Latitude, Inspiron, XPS and Precision Mobile workstation notebooks between April 2004 & July 2006.

www.dellbatteryprogram.com

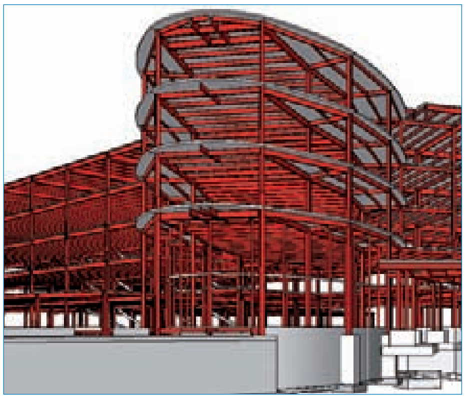
Research highlights benefits of collaboration



Independent research commissioned by the Network for Construction Collaboration Technology Providers (NCCTP) shows that 74% of clients increasingly favour contractors with experience of using web-based collaboration systems – or 'project extranets' - to deliver construction projects.

The 'Proving Collaboration Pays' study, carried out by Benchmark Research, also found project teams welcome the greater control over their projects that collaboration technologies gave them. To download a copy of the report go to ***www.ncctp.net***

Revit Structure delivers at Atkins



The UK's largest engineering consultancy, Atkins has completed its pilot of the new Autodesk AutoCAD Revit Series – Structure (Revit Structure). According to Atkins associate Chris Pembridge, Revit Structure helped increase efficiency, accuracy and design flexibility.

"We leave no stone unturned when it comes to maintaining and improving the quality of our work to clients. Anything that cuts out tedious, routine work serves the dual purpose of saving time and eliminating opportunities for error and so gives us a real head start," says Pembridge.

Because Revit Structure simultaneously creates a physical model for design, co-ordination and documentation, plus a fully-associated analytical model, it means information needs to be entered only once. In this way it acts as a common front-end and an application programming interface (API) enables third party applications to import the AutoCAD Revit Series-Structure model and analyse the data.

The results are then fed back into Revit Structure and the model can be automatically updated. "This way we can continue to use our Robot Millennium analysis software tools we know and trust, but everything is streamlined and consistent," concludes Pembridge.

Meanwhile, turn to page 17 for a full review of Revit Structure 3, the first version to be launched in the UK.

www.autodesk.co.uk/revitstructure

One in five UK projects "ends in dispute"

18 percent of projects result in serious disputes, which can delay projects and destroy client/contractor relations. This is the conclusion of research from BuildOnline, the leading global on demand collaboration specialist.

Poor document management is to blame for creating major lags, with employees wasting over two hours per week searching for documents. 63 per cent of workers also have problems when sharing drawings with contractors, as they do not work from the most up-to-date versions.

"In this day and age, it's short-sighted to blame document mix-ups for delayed projects," said Bob Godfrey, Managing Director, northern Europe BuildOnline. "Online collaboration is a quick and effective approach to project management, ensuring one version of information throughout the project's lifecycle. With collaboration, projects can be finished on time and to budget."

www.buildonline.com

eMapSite unveils new digital map service

Plans Ahead is the latest online service from eMapSite providing what is claimed to be the country's most up to date and detailed mapping based on the Ordnance Survey's 1:1,250 scale MasterMap.

Environmental consultants, planners, consulting engineers, developers and surveyors are among the many professionals who are being targeted with the new 'Plans Ahead' service which provides instant access to the latest mapping, detailed aerial photography and environmental data for their project sites. The Plans Ahead online service enables users to search, identify project sites, investigate, customise, print and export into their own applications.

In addition to Ordnance Survey's latest OS MasterMap users will also have access to the most recently captured aerial photography from other suppliers at high resolutions to best illustrate natural environment and real features.

www.emapsite.com/plansahead

BIM Executive Summit proceedings now online

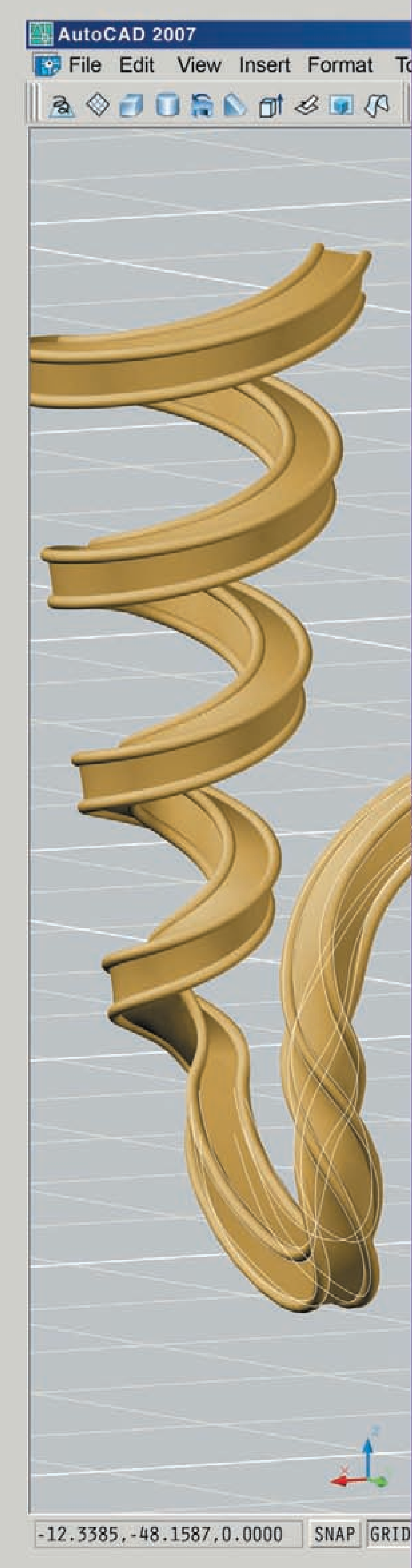
Bentley Systems has announced that the entire set of presentations from the recent BIM Executive Summit in London is now available at ***www.bentley.com/bimsummit***.

The event was sponsored by Bentley and keynoted by Lord Sebastian Coe, chairman of the London Organising Committee for the 2012 Olympics. Achim Menges, studio master of Emergent Technologies at the Architectural Association and recipient of the 2005 Educator of the Year BE Award of Excellence, served as host.

At the summit, prominent building industry executives from the UK, Europe, and Dubai gathered to discuss new technology-enabled design methods, share Building Information Modelling (BIM) best practices and exchange ideas in think tank sessions on where this technology and its application are headed.

At the summit, J. Parrish of Arup Sport reviewed the use of BIM for the design and operation of facilities at the Olympic Games and other major events. His presentation was followed by Lord Coe's keynote on the critical importance of infrastructure for the 2012 Olympics.

Other speakers at the event included representatives from Al-Futtaim Carillion, Building Design Partnership, Dubai Festival City, Foster and Partners, Hamilton Associates, Keppie Design, PLH arkitekter, Richard Rogers Partnership, Whitbybird, and Zisman Bowyer & Partners. Topics included "BIM for Architecture," "BIM for Engineering," and "BIM in a Managed Environment."


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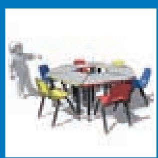


AutoTURN 5.1 supports AutoCAD 2007 and V8 XM



The high-end vehicle swept path software, AutoTURN 5.1, from Transoft Solutions, the creator of CAD-based software solutions for the transportation design sector, has been updated to make it compatible with the latest AutoCAD 2007 and MicroStation V8 XM platforms. ***www.transoftsolutions.com***

FormFonts 3D launches online Revit Channel



FormFonts 3D, the provider of 3D components on the web, has announced the beta release of its new Revit Channel. The new channel site has 2,000+ 3D models in Revit format. Most models (even 3D Trees) are below 500kb, allowing design teams to stage their building models with multiple components without sacrificing overall model size and graphic performance, the company claims. ***http://revit.formfonts.com***

Open API added to Tekla Structures v12



Tekla has unveiled the latest release of its modelling software for the construction industry. Tekla Structures 12 is designed for the entire structural design process, from conceptual design to fabrication, erection and construction. According to Tekla, the most significant enhancement is the new open application programming interface (API), which makes it possible to tie the different design applications and disciplines into a common 3D model. ***www.tekla.com***

Bentley to expand conceptual design reach



Bentley Systems has been working with Google's SketchUp development team to further expand the conceptual design tools available to users of Bentley's BIM solutions. As a result, Bentley users can now readily import SketchUp's 3D designs into MicroStation and Bentley Architecture. In addition, Bentley has established a direct connection to the Google 3D Warehouse, enabling users to easily access from within MicroStation the variety of SketchUp models stored in the warehouse.

Currently, Bentley users can read SketchUp SKP files in MicroStation and save them as DGN files. In the near future, Bentley users will also be able to write SKP SketchUp files from MicroStation. ***www.bentley.com***

Emirates stadium delivered on time



4Projects, a provider of on-demand collaboration software, is celebrating the opening of Arsenal Football Club's stunning new Emirates Stadium. The 60,000 seat arena, which opened this summer with Dennis Bergkamp's testimonial, was completed over two weeks early – and on budget – with help from 4Projects, providers of the collaborative extranet on the project.

Built by main contractor Sir Robert McAlpine, the stadium has already been hailed as a major success. With the total project costing a total of £390m, and covering a site of 17 acres, the construction has taken little over two years to complete.

The 4Projects system manages all drawings and other technical documents on major projects, allowing all of those involved to securely access up to date information and to help manage the delivery of the project ahead of programme. During the project, which started in March 2004, almost 450 users from more than 110 different organisations have used the 4Projects solution. A total of 55,000 drawings have been stored on the extranet, with over 600,000 files downloaded in what has been a text-book project. ***www.4projects.co.uk***

EatyourCAD unveils CAD managers forum

EatyourCAD is sponsoring the first UK CAD managers forum to be held on Thursday 14th September at the Royal Institute of British Architects in London. The forum, the first of its kind to be held in the UK, is claimed to offer a unique learning opportunity for CAD Managers, where they can debate and exchange ideas, independent from any software vendors or sales pitches.

Hot topics up for discussion include: Information Exchange - the challenges faced and best practice advice for issuing digital drawings, documentation and CAD data; CAD Standards - the real state of CAD standards and how to ensure compliance within your office; Continuing Professional Development - approaches to training, gaining the maximum return on cost and how to raise performance; and The CAD Manager as a Professional - what it means to be a CAD Manager in this constantly evolving world of technology and discuss professional recognition.

Based on the findings the Forum will deliver a series of best practice guides for managers. It will also produce open letters to software vendors and professional bodies to advise them on their priorities. ***www.eatyourcad.com***

Cad-Capture delivers management solution

Cad-Capture and Hummingbird have implemented a project centric content management solution for Parsons Brinkerhoff, one of the world's leading planning, engineering, program and construction management and operations and maintenance firms.

Comprising core Hummingbird Enterprise - DM and Collaboration technology components, the solution enables Parsons Brinckerhoff to manage, share and collaborate on a variety of project related content - such as e-mails, drawings, and project plans - with third party project participants including clients, suppliers and contractors.

Involved in scoping and implementing the solution, Cad-Capture also delivered various drawing management components including direct integration for AutoCAD with support for xrefs and synchronisation of title block attributes for efficient profiling using its CaptureLink for AutoCAD client extension for Hummingbird Enterprise - DM, as well as the ability to view, print and mark-up a variety of project related content, including native 2D CAD formats. ***www.cadcap.co.uk***

Arup looks to solve the problem of managing emails

Arup's software business Oasys has announced the launch of Version 4 of its low cost email management tool Mail Manager and has formed a relationship with resellers Irradiant to market the Outlook plug-in.

"Mail Manager makes it easy for Outlook users to save emails and search for them in file system folders", says Irradiant CEO Nick Klemz. "This encourages users to treat email as methodically as they treat paper documents."

Mail Manager is designed to simplify and speed up the process of filing emails and adds to Outlook the ability to search through folders on network drives for saved messages and their attachments. Mail Manager also includes what its developers call common-sense workflow functions that are claimed to help cut printing costs, reduce storage overheads and improve teamwork. By allowing users to add their name or initials to emails that have been read and reviewed, Mail Manager cuts the number of messages which are printed and stored as hard copies and gives managers the means to approve emails before they are sent out.

Additionally, Mail Manager enables users to share email with colleagues by distributing hyperlinks to saved documents, thus avoiding sending multiple copies of messages and bulky attachments to intended recipients. ***www.oasys-software.com***



Faro launches AEC scanning tool



Faro Technologies has released a set of specialised software packages that are designed to enhance the capability of its Laser Scanner LS product line.

One of the packages, Faro Architecture with Autodesk ADT, has been specifically created to help model buildings quickly. The system includes an Object Library, which, according to Faro, not only speeds up the modelling process, but also fills its database with all the items in order to create quick statistics of the used building components for cost calculations and reports.

The Faro Laser Scanner LS is a portable, computerised measurement device that creates a high-resolution, 3D, digital "photograph" by scanning everything in its 360- degree path up to 80m away. It collects 120,000 points per second with up to 3mm accuracy, while the system's laptop draws and records all of the object's 3D measurements.

Other dedicated packages include Faro Heritage with JRC's Reconstructor, Faro Process, Power & Piping with INOVx's PlantLINx, Faro Process, Power & Piping with BitWyse's LaserGenSuite and Faro Tunnel & Mining with ATS's RR-Tunnel and Mining. ***www.faro.com***

New mobile scanner to map highways in 3D



3D Laser Mapping has launched StreetMapper, a new mobile system for the capture of detailed 3D map data. The vehicle-mounted system uses a series of lasers to measure the position of features relative to the vehicle, which can survey at speeds of up to 70km an hour. These measurements are then processed to produce a detailed 3D model of the street corridor and overhead features.

StreetMapper has been developed in partnership with IGI, a company specialising in navigation and precise positioning for aerial survey, based in Germany. In the UK, the system is already being used by Reality Mapping to enable high-speed data collection

"We specialise in applying new technology for the rapid collection of accurate survey and mapping data. StreetMapper will revolutionise the way we map the streets of our cities, towns and villages as it provides more detailed and accurate measurements than traditional survey techniques, said Martin Redstall, Managing Director of Reality Mapping. "Operating at speeds of up to 70km an hour we can safely conduct surveys to create highly detailed base mapping of the road network and associated assets such as road signage, street lighting and vegetation along the road corridor. StreetMapper can also provide evidence of street side construction and environmental hazards."

StreetMapper uses laser scanning technology to measure the position of features relative to the vehicle on which the system is mounted. The lasers transmit a light pulse that is reflected off the road surface or roadside feature and bounced back to the vehicle mounted receiver. Using the time taken for each individual pulse to be returned and the known value of the speed of light the StreetMapper system can automatically calculate the distance of the feature from the vehicle.

StreetMapper is also accurately calibrated so that each laser transmits its optical pulse at a known angle and uses satellite technology to calculate the exact real world position of each laser. Using basic trigonometric principles and these measurements and values the on board computer can process over 40,000 points per second to produce highly detailed and accurate three dimensional models.

StreetMapper is the latest addition to 3D Laser Mapping's product portfolio that includes both terrestrial and airborne laser scanning solutions. ***www.3dlasermapping.com***

SolidWorks helps streamline interior design

UK-based Ergotechnics has standardised on SolidWorks 3D CAD software to design store layouts, retail displays, and interiors for mainstream retailers. The company also uses the eDrawings e-mail-enabled design communication tool to help share concepts between designers and contractors.

With SolidWorks, Ergotechnics has developed technical methods to create parametric 3D models of retail and interior components sometimes working from no more than a conceptual sketch. The 3D model contains the complete manufacturing data, allowing for precise production details and a full bill of materials ensuring contractors have all the information to build accurately.

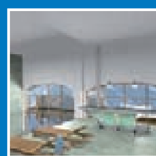
"SolidWorks lets us create a library of standard, reusable parts that can reduce assembly design to a series of mouseclicks," said Matt Lawrence, Ergotechnics office manager. ***www.solidworks.com***

Record year for Coins Three Peaks Challenge



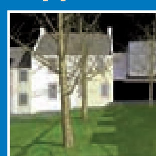
The Coins Three Peaks Challenge 2006 took place on 6-7 May, and involved 38 teams of 4-5 walkers apiece, from 29 construction companies, who endeavoured to climb the UK's highest mountains in 24 hours. The event raised over £270,000 for CARE International, a record-breaking total. Companies who took part include Laing O'Rourke, Balfour Beatty, BB Rail, Multiplex, Bennett Homes (also had the fastest team), B&B Construction, Sir Robert McAlpine (pictured), Connaught, Laser Holdings, Edmund Nuttall, Ringway Group, and Weston Homes. ***www.challengeseries.org.uk***

ARTVPS lights the way for design visualisation



Architects and designers wishing to create photorealistic interior images for conceptual drawings, projects do so with RenderPipe AV5.5, the latest software release from ARTVPS. RenderPipe AV5.5 uses ray tracing technology to create photorealistic images and includes a range of improved lighting features and post process image controls. ***www.artvps.com***

NavisWorks adds DWF support to JetStream



NavisWorks is shipping JetStream v5.1, the latest release of its 3D design review application. The new version adds localisation for Germany, Japan, China and France, as well as file format additions and updates, including support for Autodesk DWF format, AutoCAD 2007 and an exporter for Google Earth (.KML format). ***www.navisworks.com***

Misawa rolls out Piranesi for residential design



Misawa Homes of Japan has added Piranesi, the 3D paint rendering system, to its "MCAD" presentation system for home design. Misawa sold 12,700 houses in 2005 and will use Piranesi in its branches throughout Japan.

Kazuaki Uchida, manager of the Design and Promotion Department at Misawa Homes said, "Ever since we started creating CG home designs using Piranesi, we've been able to provide customers with a clearer image of their homes at the early, mid, and late stage of the negotiations."

Meanwhile, turn to page 25 for the latest Piranesi gallery. ***www.informatix.co.uk***

MicroStation V8: the story so far

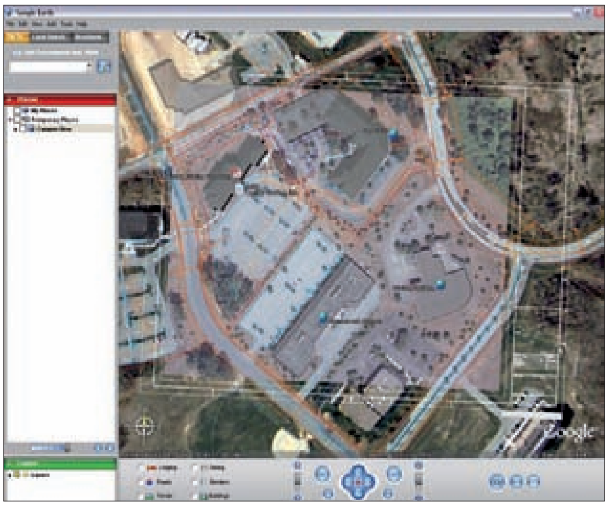
While MicroStation was almost totally re-architected in the V8 release, with Bentley adding considerable new functionality and a powerful new file format, the graphics engine had yet to be replaced and the interface was 'tired' by modern standards. XM is the completion of this work, with some new features to boot. By Martyn Day.

It's taken five years to deliver and has been completed over two major releases, but Bentley Systems' MicroStation has been rebuilt in front of the eyes of its customers, while many of them were actually sat on top of it! To look at MicroStation V8 XM (the most recent update) on its own and judge what Bentley has been doing with MicroStation would be wrong. First off, it's worth having a mini-recap of what was added in the first instalment of V8, V8 2004 Edition and then V8 XM Edition.

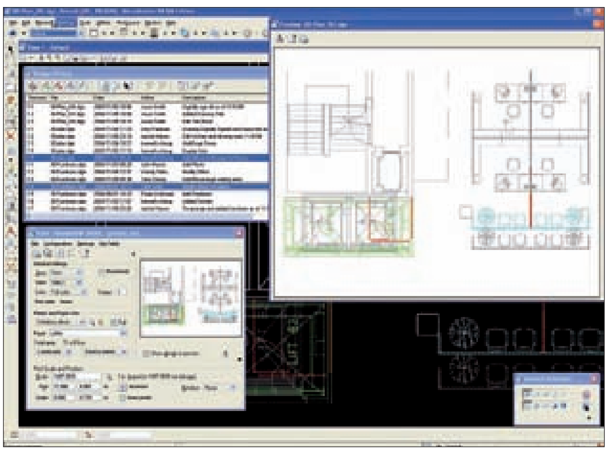
One of the key technologies in the V8 Generation, as Bentley called it, was the adoption of a much better way to work with its nemesis' CAD file format, DWG. For many years, MicroStation customers had some support for DWG provided by Bentley but the company was always under fire for the ease of use and lack of success that customers were feeling around integrating into a DWG-based workflow. For V8, Bentley pulled off a pretty impressive feat - it took the feature set of AutoCAD and most of its entities and added them into MicroStation, together with historical MicroStation commands and new V8 functionality. In many ways V8 was a super-set of both products.

According to Joe Croser, Bentley's Global Marketing Director for Platform products, "We develop software for the world's infrastructure - projects are large and necessarily collaborative and smooth collaboration is paramount to successful projects. As a responsible vendor we work hard to make sure users of our software can work a little easier when collaborating on large projects. Hence our DWG support, it is a part of the world we serve. 95% of the world's infrastructure is designed, built and maintained using DWG and DGN file formats. Large users have a need to work directly with both file formats. That is what we deliver with MicroStation, an ability to work directly with both file formats."

In the past, the problem of converting MicroStation elements into DWG and vice versa always produced a compromise as MicroStation and AutoCAD elements were just different and it was always impossible to define and save elements as DWG, or DGN had no way of correctly expressing them. The following year, after V8 had been released, at the Bentley User conference, the Bentley brothers' Q&A session with customers didn't include one question about DWG or problems about working within a DWG workflow, a topic which had always been raised. The decision to build in entities that were DWG compatible, together with extended MicroStation features, allowed users to work in a DWG compatible mode or in the superset, without



Bentley's model includes a subscription element called SELECT. Throughout the year, Bentley release updates and new functionality to MicroStation. This year the company added support for Google Earth in one of its SELECT updates, allowing MicroStation customers to output their designs and place them in a Google Earth environment. Cool stuff.



Roll backwards or forwards through milestone changes within a DGN file. It's not unlike a time machine, showing the status of the file throughout its design life.

angular and radial measurements while checking for broken dimensions, as well as an automatic conversion between Imperial and Metric. References could also be nested, providing interoperability with XREFs in DWG and supported multiple sheet definitions. At the high-end surfacing, solids, meshing and new rendering options, such as particle trace, were added, together with parametric cells.

While V8 2004 Edition was being launched at Bentley annual BE event, Bentley was holding private sessions showing the work that was being done on the new interface and graphics pipeline that was very much in development, although I remember seeing a complete Harley Davidson motorbike modelled in the 'next release', codenamed Mozart (which was to become XM). Under this guise, MicroStation had more in common with some of the MCAD tools I was familiar with - Dassault Systemes, SolidWorks and Autodesk's Inventor. It looked very slick. And this just about brings us up to date.

MicroStation V8 XM

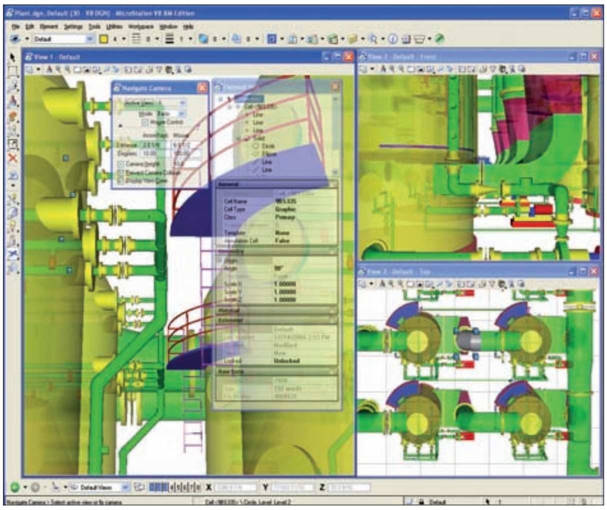
XM had quite an extended beta, taking a considerable gestation period to make it to birth. Changing something as fundamental as the graphics pipeline is probably just as complicated as the original work in the database that went into V8's AutoCAD entity support. Changing Graphical User Interface (GUIs) is also always a contentious issue for customers who have trained and used a product for years. But MicroStation had to change. It was very much out of step with contemporary CAD programs and while Bentley has many large 3D users, the interface was decidedly 1980s.

MicroStation XM is no longer Open GL-based but relies on Microsoft's Direct X technology, which has been mainly used in the gaming industry. Workstations running XM will probably need to at least have their graphics card drivers updated and Bentley provides a useful utility called 'Bentley Desktop Analyser' to help diagnose any shortcomings in your hardware.

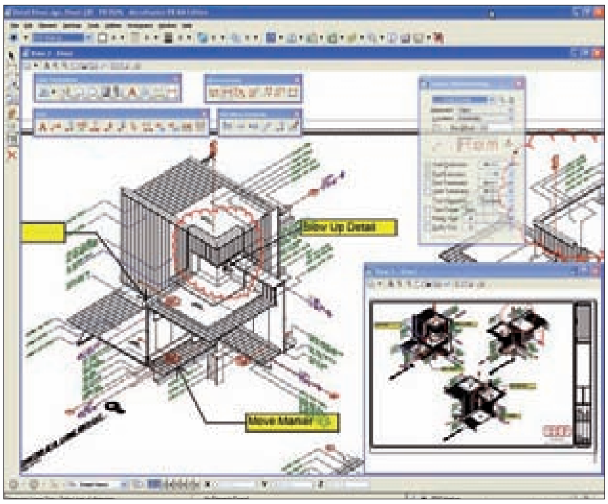
There are two interfaces on offer: classic, for those that want familiarity of previous releases and there's the new one which is more of a contemporary Windows XP look and feel. When used in conjunction with new keyboard shortcuts and mouse button mappings, Bentley Systems is quoting productivity improvements of up to 300% - 400% over the previous interface. The Keyboard Position Assignments are a patented feature that provides immediate access to any MicroStation command at the stroke of a key and programmable mouse functionality to increase the performance of view and model navigation.

The new GUI looks a lot less cluttered and very clean. I guess the problem will be a cultural one - of getting users, set in their ways, to warm to a new interface. While initially an inhibitor, the promise of much greater productivity may get MicroStation users on-side.

Once set up, while the 'classic' interface obeys enough standard MicroStation conventions, you get vastly improved real-time 3D performance with the benefits of modern live rendering effects like 3D translucency; the rendering quality is really very high quality. And of course if you work in 3D, you can save



The powerful upgraded graphics pipeline in full flow, demonstrating the real-time transparency capabilities while in a process plant model



your models and animations inside the enhanced PDF format.

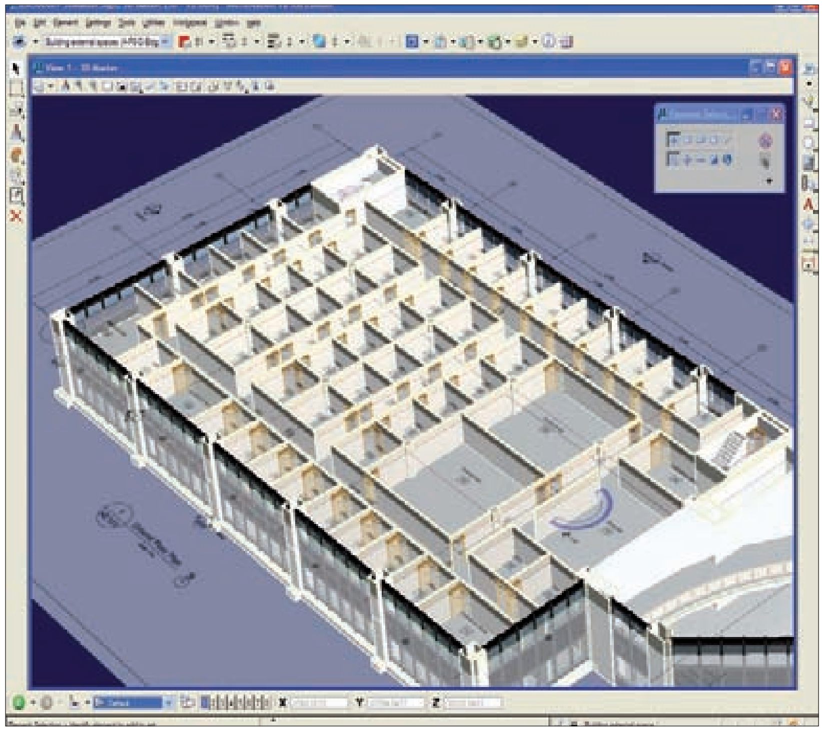
PDFs can also be referenced as an attachment and dynamically manipulate the reference clipping boundaries with handles, and attach multiple instances of the same model at different stages of development using Design History. MicroStation understands 24-bit colours and Pantone swatch assignment, great for WYSIWYG professional colour printing.

A new management concept called Element Templates can integrate your CAD standards with MicroStation Tasks to align features and tools with design and production workflows, so that teams can create consistent work by using approved methodology.

Outside of XM, at least that's how it will be used, Bentley has teamed up with Microsoft to offer, something it calls, ProjectWise StartPoint. This is a 'free' version of ProjectWise that is based on Microsoft's Sharepoint database which is free for many users with corporate server licenses with Microsoft. This provides an entry-level collaboration tool to manage, find, and share CAD data, built right into the product. This could be used to manage DWG data just as easily as DGN.

With Autodesk changing the DWG file format in AutoCAD 2007, V8 XM was updated to support features added to 2006 DWG. Bentley is understood

The ability to redline and mark-up models is especially useful in collaborative workflows.



Unique at the moment, MicroStation can load up a PDF and use the engineering information as a reference file, here providing the plan of a building which has been modelled in 3D in MicroStation V8 XM

to be working on the 2007 DWG format with the Open Design Alliance. It's also of note that for the first time in living memory Autodesk is about to retrofit MicroStation V8 DGN capabilities (2D only) to AutoCAD. This is either in recognition that Bentley customers are Autodesk customers, or it's an aggressive move to get into some of Bentley's accounts, as Autodesk has its eyes on the civils market.

One of the other innovative new things in V8 XM are the Link Sets. Here, a bit like custom hyperlinks, ad hoc relationships between content can be described and navigated. So it's possible to create relationships and links between drawings and specification documents and across formats including DGN, DWG, PDF, and Office formats.

Conclusion

There's a load of new features in MicroStation V8 XM and the graphics capabilities have certainly received a big shot in the arm. The new interface was desperately needed and has brought MicroStation into the 21st Century. When looking at V8 in the context of the whole re-architecting project, it's a pretty amazing software engineering feat to have so thoroughly reworked a product to expand and modernise, while maintaining links back to past releases. From talking to Keith Bentley while the project was in development there was concern that the company was trying to do too much in too short a space. Maybe five years plus wasn't the kind of timeline originally envisaged but it has provided Bentley with plenty of time to work on new innovations and keep with the leaders in the 3D field. MicroStation is a better product for the work and a platform which the company can continue to develop its very specialised vertical 3D applications on.

The decision to rework the DGN format once in about 15 years, to include native DWG concepts and force a format change on customers was not taken lightly, and Bentley is quick to point out the suffering that some of its competitors hand out to customers with file format changes every 2-3 years. Even though so many new things have been added to MicroStation in this multi-year revamp, the DGN format hasn't changed, leading me to think that most of the functionality was already mapped out and catered for in the original V8 format.

With MicroStation now having so much in common with the mid-range MCAD products, I wonder if there's any appetite to get back into the MCAD market, with a successor to MicroStation Modeler? Many of the demo models presented by Bentley appear to be engines and motorbikes. It's hard to tell if this is the simply the interest of the demo jocks or just a potential use of the highly 3D capable application?

www.bentley.com

We have a substantial interview with Joe Croser, Bentley's Global Marketing Director for Platform products in the next issue, looking at the specifics of the changes to MicroStation's 3D graphics.

"When looking at V8 in the context of the whole re-architecting project, it's a pretty amazing software engineering feat to have so thoroughly reworked a product to expand and modernise, while maintaining links back to past releases."

BIM for structural design

More than simply a collection of tools for representing designs and engineering parameters, BIM is a practical technology shift that directly benefits engineers' productivity, collaboration, and accuracy says Phillip G. Bernstein, FAIA.

China, it seems, is one giant construction project, and like all giants, it has a large appetite – in this case, for steel. Half a world away, China's steel consumption has created indigestion for European architects and structural engineers, forcing them to struggle with the spiralling cost and availability of structural steel for their projects. With each change in the price of steel - sometimes weekly - project costs escalate, necessitating a constant process of redesign as teams strive to hit construction budget targets.

And with each such cycle, you can hear the cry of the structural engineers, asked once more to reduce the cost of the work: "Not again!"

Of course, China and steel is hardly the only challenge structural engineers face on projects large and small. And in most of those projects, the cost and associated tedium of these changes are skewed to the later stages of a project, as the architects and developers become better acquainted with the engineering issues.

It's time to place some renewed vigour behind an idea structural engineers, architects and others have discussed for years: the extension of Building Information Modelling, or BIM, throughout the entire enterprise and industry.

The core idea of BIM, applied to structural engineering, is to deliver information that is co-ordinated, internally consistent, and computable - that is, where the computer knows how to treat the aggregated data like a building. For many engineers, this is already accepted practice - and it has already begun delivering efficiencies and bottom-line benefits. Indeed BIM has reached acceptance among many architects as well, and in some cases the resultant collaborations have led to tremendous productivity gains.

Unfortunately, BIM remains underused throughout the building process. Even if some professionals on a given project are using BIM and technology that supports it, the conventional design and construction process typically transfers information from one phase to the next via paper. Time has always been money, but in the modern building environment, this kind of disconnect among disciplines is too expensive and time consuming to continue.

Properly integrated into the traditional processes between designers and engineers, BIM offers the chance to not only reduce the disruption of frequent or late changes, freeing up the engineers' time for more challenging work, but also to greatly improve client satisfaction.



BIM: practical and tactical vs transformational change

Often, technology changes in a traditional business such as structural engineering are portrayed as requiring dramatic transformation in the ways professionals work. Inherent in this view, though, is the notion that the transformation will be so profound that it will take years of work and a huge budget to implement.

It also has professionals wondering how their jobs will change - and if, in fact, the "transformation" will make it impossible for them to practice the profession for which they have trained in ways they understand.

BIM, however, can be viewed in a much different light. Its promise is not to create some incredible shift in the fundamentals of structural engineering.

It won't change the use of carefully constructed analytical models engineers have built over the years. Nor does it replace proven analysis applications like Robobat, CSC or Sofistik.

"BIM affords an outstanding opportunity for structural engineers in particular to take a leadership role as the rest of the building industry begins to adapt and adopt model-based tools"

Instead, what it does provide is a common modelling front-end to interface with those applications and a common model to document the results. This provides both technical and tactical business advantages to structural engineering firms - improving communication with clients, speeding up the process of making changes that are out of the control of the engineer, and delivering final work products more efficiently. This can both improve profit margins and free up time to take on additional projects.

BIM can serve as an effective bridge between a structural design's analytical model and its physical representation and a link to the rest of the building process, offering breakthrough opportunities for efficient collaboration across design to construction - and a lot less paper. Purpose-built BIM software now exists for architects, structural and even building services engineers; technology that literally blends CAD with the data and 3D models resulting from performance analysis, in a high-fidelity, functional model.

By adopting technology that supports the use of BIM - and encouraging its adoption throughout the AEC industry - structural engineering firms can address four major areas of concern: creating greater efficiency through concurrent modelling; increasing the quality of work using parametric change management; improving design flexibility by better accommodating design alternatives and supporting more effective collaboration

Creating greater efficiency

For structural engineers whose work long has depended on analytical models that predict performance, the immediate promise of BIM and related tools and technology is greater efficiency.

Structural engineers must be particularly adept at reacting to late-stage changes that demand compromise because it's often "too late" or too expensive to alter physical design. One of the major issues with last-minute changes to a project is the need to re-enter information for those changes. First, models must be updated to perform the variety of analyses demanded by changes in structure or materials. After those analyses are completed, the results must be communicated across the project team and require meticulous insertion of new data in all building documentation. Too often the resulting data isn't completely co-ordinated into the production documents, creating further difficulties in the field.

Typically those changes have been made using

continues on page 15



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continued from page 12

paper as the medium, or with multiple entries into discipline-specific software, both within the engineering firm and with designers and other partners. This kind of manual co-ordination and redundant data entry isn't engineering - it's tedious inefficiency, and a tremendous waste of the experienced professionals and highly-trained staff at an engineering firm.

BIM technology, by contrast, aggregates all the relevant data into a consolidated, dynamic model that is integrated with analytical models, architectural design and rendering software and that treats the data in that model holistically. Late-stage changes can be made with a minimum of data entry, drastically reducing the expense of those changes (which can wreck havoc on what little of a project's budget remains toward a project's end).

By eliminating the need to set aside large chunks of an engineer's time for the tedious redrafting and co-ordination of inevitable changes, that time can be used for a better purpose: engineering and problem-solving, which add far greater value to a project.

Improving quality

One of the natural by-products of the reduction in repetitive data entry made possible under the BIM structure is a reduction in the errors introduced by design changes. Errors are always a possibility whenever changes are made, because humans make mistakes. But errors are practically a given when the changes are complex, and are accompanied by the stress and rush associated with the late stages of a project.

When a client is demanding a completed set of documents to hit a delivery deadline, it's easy to imagine small computational mistakes cropping up - even in just one model, they will create errors, add to lost time, and translate to lost reputation as well. BIM can help avoid that problem through parametric change management capabilities.

In other words, a change made once to any parameter or element in the design is instantly reflected in every representation of that element in the design - including, with the right technology, bi-lateral links with existing specialised tools for analysis. Any other parameters that are linked to the change are also changed appropriately. The approach improves quality, because not only can engineers rely on the results, design team partners can count on the information provided to them to be the best possible quality.

The value is increased exponentially if those partners are also using technology that understands BIM data, because now everything is linked - and every change is reflected accurately all along the line. This is the vision behind an integrated, BIM-based project.

Better design flexibility

As long as the tedium of change management rules the day, what are the chances that engineers will examine all the structural design alternatives that present themselves with a late change in a project? Chances are the team will choose one or two alternatives their experience tells them are likely to work, methodically enter the data for the changes, run the numbers, repeat the process, choose the better of the two alternatives, and call it a day.

It's always possible that another approach - a different strategy, or an alternate material, for example - would provide a better, more elegant or more efficient solution. With the time and budget freedom afforded by the use of BIM across the project, engineers are free to consider such alternatives - the kind of work for which they have trained. More flexibility also leads to more satisfied customers.

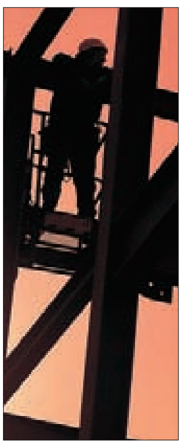
More effective collaboration

Even applying BIM in the structural engineering office alone offers great benefits. No matter how a project's architects prefer to share design information, even on paper, BIM at the engineering firm makes it easier to analyse late changes and rapidly return the data to the architect for examination.

Within the last few years, however, technology has come to market to help architects make the transition to BIM themselves. The best of these technologies use parametric change management technology for the structural engineer. Linking these technologies together further eliminates errors while automating the communication of changes between the partners in the AEC process.

By now, it's clear that employing BIM from design to build creates a new kind of faster and more efficient collaboration. And that leads to better decisions all around - the kinds of decisions that involve big money. The IT Construction Best Practice Service notes that in the UK, the annual cost of rectifying construction defects caused by poor drawings and incorrect instructions has been put at £1 billion.

The experience of structural engineering firm, Atkins Global is typical of firms that have begun examining tools for BIM and the potential impact on its work for clients in the government, commercial and industrial sectors. So far, the company has seen great benefits from using the one model for multiple third-party analysis, cutting this process down from two weeks to two days.



The firm expects even greater gains, anticipating that overall, its teams' documentation, drawing production and co-ordination, and integration of design changes will take place in a far timelier manner.

Conclusion

More than simply a collection of tools for representing designs and engineering parameters, BIM is a practical technology shift that directly benefits engineers' productivity, collaboration, and accuracy. While investment in training and transitioning staff is required to implement building information modelling, it is an investment that will quickly lead to tremendous benefits in both profitability and client satisfaction.

BIM also opens the potential to another transformation in the industry, one that's key in this world of pressure on razor-thin margins and multinational teams and projects. These realities demand new business models that integrate design and construction, such as design/build, that combine some of the tasks and responsibilities that traditionally belong to separate architecture, engineering and construction entities. BIM offers the key to consolidating them within one organisation or project team.

Given that modelling abstract concepts forms the foundation of the discipline of structural engineering, BIM affords an outstanding opportunity for structural engineers in particular to take a leadership role as the rest of the building industry begins to adapt and adopt model-based tools to coordinate design intent, structural performance and execution and achieve quality design that yields high-performance buildings.

About the author: Phillip G. Bernstein, FAIA, is Lecturer in Professional Practice at the Yale University School of Architecture and vice president of the Building Solutions Division of Autodesk, where he sets the direction of technology solutions for the building industry. Bernstein was formerly an associate principal at Cesar Pelli & Associates Architects.

www.autodesk.co.uk

Revit Structure 3

With Revit Structure an analytical model is automatically generated as you create your physical model. The analytical model can then be linked to a third party structural analysis application and the physical model automatically updated from the results. Greg Corke looks at Version 3, the first to be released for the UK market.

Revit Building was only ever meant to be one part of the much bigger picture that is BIM. The parametric building modeller, which provides the architectural element to Autodesk's Building Information Modelling philosophy, has now been joined by a structural engineering partner, Revit Structure. The product was launched in the US last year, but it has taken 12 months for it to make its way across the pond, maturing into third release and picking up localisation for the UK market on the way.

Revit Structure is a design and documentation solution specifically developed for structural engineers. Like Revit Building, it is a database-driven application built around a single model. You can view your model in 2D, 3D, elevation, section, and detail and each will give you a live view taken from the master database. All of these views are stored in a central project browser rather than in individual files and any changes made, such as moving the position of a member, will be reflected across the whole project. This isn't just restricted to geometry however, as the master model can also be amended by making changes to linked schedules – by altering the size of a column, for example.

This is a different approach to many 3D systems which derive 2D drawings and schedule data from a master 3D model, but not the other way around. With Revit Structure's change management engine everything is linked – a change made in one view is propagated everywhere.

Whereas Revit Building uses a single model, Revit Structure uses two and automatically generates an editable analytical model alongside the physical model you create. The physical model, which shows a true representation of what structural elements look like, is used for layout, drawing production and documentation, whereas the analytical model can be bi-directionally linked to third-party structural analysis applications to enable a more integrated design process. Any design changes made in your analysis application can be brought back into Revit Structure and both the analytical and physical model (and of course any related documentation) automatically updated.

Working with structural models

In an ideal world the starting point for any Revit Structure model would be a 3D Revit Building model sent direct from the architect. This can streamline the whole model creation process as engineers can share the same underlying database and define structural members directly from the architectural model.

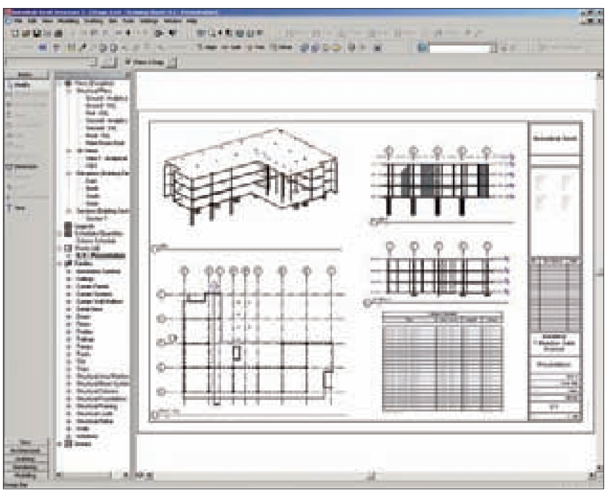
Working alongside Revit Building also has benefits downstream and interference checking can be carried out between architectural and structural elements and once the models are linked both architect and engineer can be notified of any changes made to the architectural/structural model using the copy/monitor tool.

For example, if an architect moves a column, the structural engineer will be automatically notified when the models are next linked up. The change can then be accepted, postponed or rejected.

3D models can also be imported from Architectural Desktop, and engineers can use plan views as a reference when starting their structural layouts. To help co-ordinate designs structural engineers can also export their Revit Structure models to Architectural Desktop, creating true ADT objects. Links to Autodesk Building Systems (used by mechanical and electrical engineers) and IFCs (Industry Foundation Classes) are also provided.

Despite the additional benefits that come from working with a complementary 3D architectural product, a more common starting point is to import a 2D DWG, DXF, or MicroStation DGN file. Here, structural elements such as walls and grids, can be created simply by clicking on the appropriate 2D lines.

Of course all the sharing of 2D and 3D data relies on the premise that the structural engineer fully trusts the integrity of the architectural model, which is still not often the case in the construction industry. There is still a fair amount of distrust of CAD data and the standard deliverable continues to be the printed drawing, complete with the legally binding signature. As a result, many structural engineers may prefer to start modelling from scratch, though this sharing of data may prove to be very popular in design/build companies, where there is a collective responsibility.



Revit Structure accelerates the generation of design documentation by enabling users to create elevations, plans, and sections automatically from the master model. Edits can be made to any view and propagated in every related view.

Structural analysis software links

Through Revit Structure's API third party software developers can provide bi-directional links to their structural analysis applications. These currently include:

Robot Millennium from **Robobat**
(www.revit.robobat.com)
RAM Structural System from **RAM Intl**
(www.ramint.com/support/revit.jsp)
RISA-3D and **RISAFloor** from **RISA Technologies**
(www.risatech.com/partner)
Smart Modeller from **CADS**
(www.cads.co.uk)
Fastrak and **S-Frame** from **CSC**
(www.cscworld.com)
GSA from **Oasys Software (Arup)** (coming later this year)
(www.oasys-software.com/products)

Whatever the starting point for the project, Revit Structure provides a range of parametric structural modelling tools, which can be used to generate your model in either a 2D or 3D view. The depth of tools is fairly extensive, including grids, beams, beams systems, intelligent wall families, bracing, slabs, and foundations to name but a few. One notable omission is cold rolled steel and Autodesk is currently working with UK manufacturers to deliver a library of Z purlins and rails. Elsewhere, structural steel components have been localised for both UK and European standards in Revit Structure 3 and these are selected from a pull down list, along with material type and size.

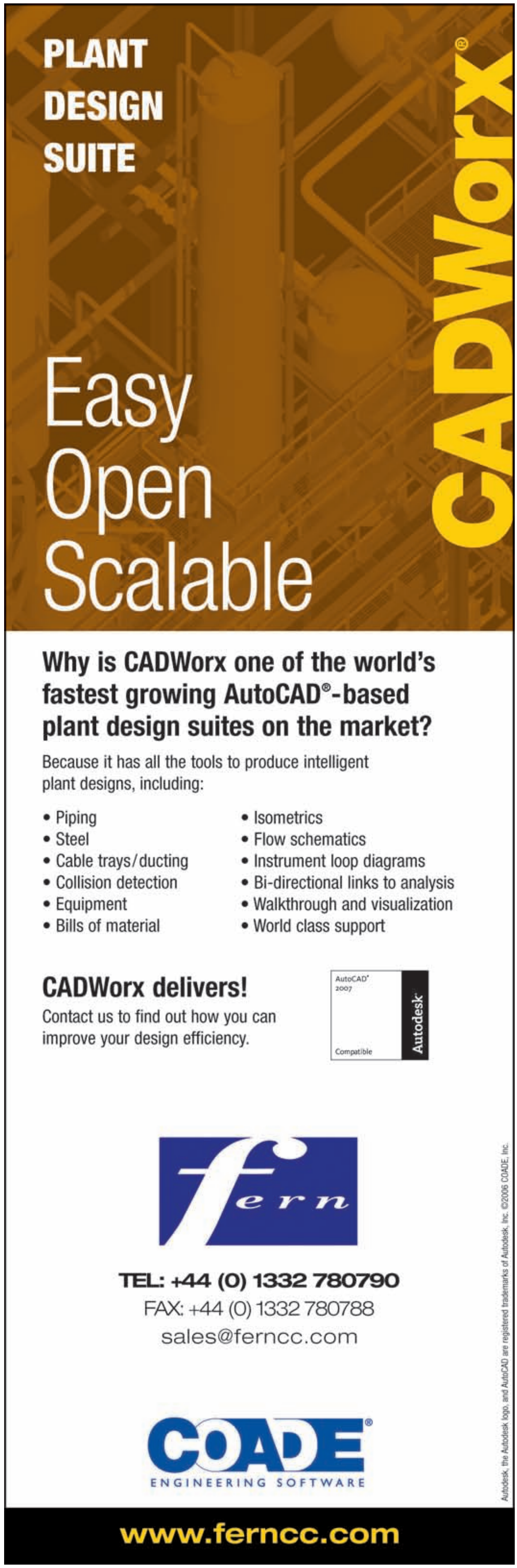
With Revit Structure's object–based architecture, columns automatically snap to grids and beams snap to columns or gridlines. If the grid is changed at any time during the project, all the related components will follow. Of course, the beauty of Revit Structure is that many components can be modelled parametrically. For example, secondary beam systems can be defined not only by their spacing, but by the number of beams within a defined length. Then, if this length is changed, the system will automatically update the position of the beams.

In a typical building, the structural engineer will complete a single level, then copy and paste the structural components onto the other levels, quickly building up a complete structure.

While this entire modelling process is centred around the physical model, at the same time Revit Structure automatically generates a fully associative analytical model, consisting of elements and nodes,



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and it is this that the structural engineer can use for analysis in a range of third party applications.

Structural analysis

While the modelling functionality in Revit Structure is excellent, the feature that sets the system apart from others is its associative analytical model, which enables a bi-directional link to be formed with a range of third party structural analysis applications. With multiple analysis applications often used in a single project, the creation of a master analytical model in Revit Structure means that structural engineers do not need to re-model the same data in each individual application. This not only streamlines the whole process, but helps reduce errors and ensure that the engineer is always working on the latest model.

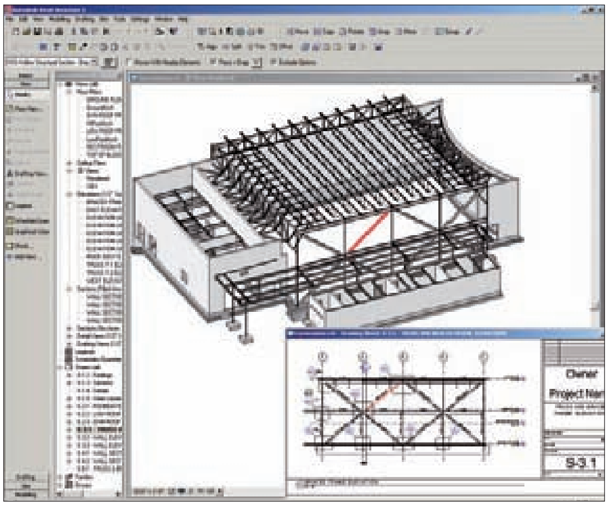
The level of integration varies from application to application and it's important to check with your chosen structural analysis software provider to see how tight this is. Developers that currently offer plug-ins for their analysis products through Revit Structure's API include Robot Millennium from Robobat, RAM Structural System from RAM Intl, RISA-3D and RISAFloor from RISA Technologies, Smart Modeller from CADS, and Fastrak and S Frame from CSC. The list is still growing and Oasys, the software arm of Arup, will be launching a plug in for GSA later this year. In addition, Revit Structure also supports the CIMSteel CIS/2 interchange standard.

Users can choose to link the whole analytical model or a subset to their chosen analysis application. This depends on the type of analysis that they want to carry out, and can be done at any time in the design process with a single mouse click. For example, the entire model could first be used for a global analysis to get reactions, sheer, force and bending moments, with a section then exported to another application to design beams or slabs.

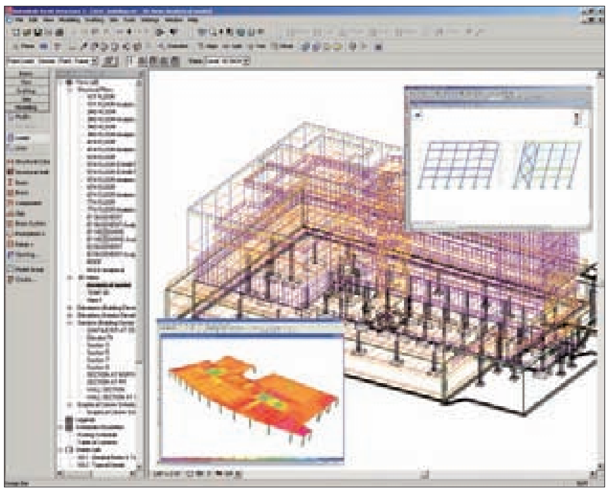
In terms of loading, you can apply basic area and point loads inside Revit Structure and these can also be exported to your chosen analysis application. However, users may find it more efficient to set up loads and load combinations inside their chosen analysis application.

Once your analyses have been solved any modifications can be fed back into Revit Structure, where it can track changes such as which members have been altered, which have been added and which have been removed. The system can then automatically update both the analytical model and physical model.

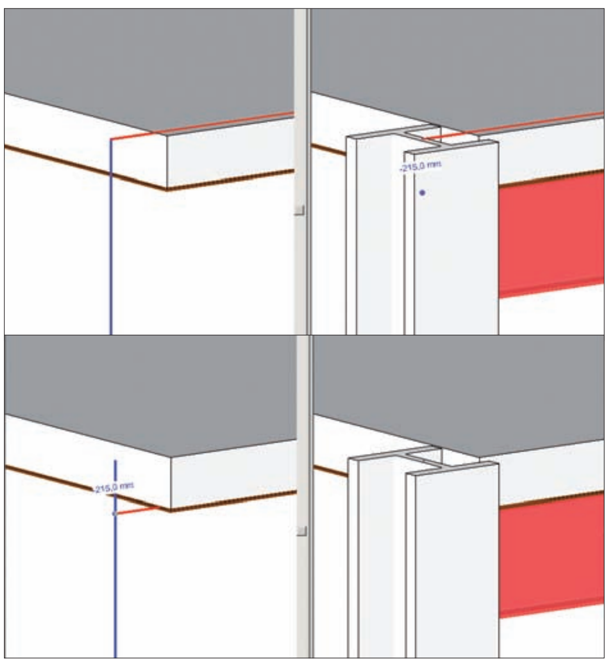
Of course, the process described above is an ideal example. The reality is that many analytical models need to be different from their physical counterparts so that they can be solved efficiently or indeed accurately. For example, as you step up through a building, the column size is typically reduced and the user will need to alter the analytical model in Revit Structure before it can be analysed accurately. This, of course can mean than the analytical and physical model are out of sync, and despite built-in tools that can check and warn if tolerances are exceeded, users need to be very aware of the implications



Every 2D and 3D view, drawing sheet, and schedule is a direct representation of information from the same underlying building database. Any time you make changes the software propagates those changes throughout the model and updates every related view or schedule.



The analytical model can be dynamically linked with external structural analysis and design programs. Bidirectional linking means that analysis results automatically update your model if any member size has changed.



Revit Structure combines a physical model (right) of the building fully associated with an analytical model (left). The analytical model is fully editable so it can be exported to a third part analysis application to produce accurate results.

of any changes, particularly when receiving updates from their third party analysis application.

Design documentation

Once the design is finalised, the creation of plans, elevations and sections in Revit Structure is very easy. Views simply need to be dragged and dropped from the project browser onto each drawing sheet. As each drawing view is still a live representation of the master model even last minute changes to the design will be automatically reflected throughout all documentation. Schedules, section labels and callouts will also be co-ordinated even if they are on separate drawing sheets.

Schedules themselves are incredibly easy to generate and include sorting, grouping filtering and counting functionality. As mentioned earlier, any changes made to the schedule will automatically be made to the master model and hence any related views.

Structural details can be created from views of the model, or generated from scratch either using Revit's 2D drafting tools or importing them from AutoCAD (which incidentally ships with AutoCAD Revit Series - Structure). AutoCAD can also be used to finish off your design documentation, but you lose the associativity with the master model.

Conclusion

With Revit Structure Autodesk is offering an extremely exciting proposition for structural engineers. The modelling tools are easy to use and the powerful change management engine, which means a change anywhere will be reflected across the whole project, is a major strength of the product. This not on only streamlines the whole design documentation process but helps reduce errors, particularly when any last minute design changes are required.

This level of functionality has been at the heart of the architecturally focussed Revit Building for some time, but the coordination of design data in Revit Structure goes beyond the integration of 2D, 3D, section views and schedules. The product's links to Revit Building and ADT also help bring the architect and structural engineer closer together by enabling the re-use of data, interference checking, and in the case of Revit Building 9 and Revit Structure 3, the monitoring of any changes made between structural and architectural models.

While this co-ordination of architectural design data will appeal to those who trust their source data, the major draw for structural engineers is certain to be the ability to establish dynamic links with a range of structural analysis applications, with Revit Structure acting as a central repository for all design updates.

And while close attention will have to be paid to any changes to the analytical model during the analysis round trip and the knock on effect to the physical model, the fact that you only need to model once to produce physical model, analytical model, and all design documentation has the potential to make Revit Structure an attractive proposition for any structural engineer. ***www.autodesk.co.uk/revitstructure***

Keeping ahead of the curve

Advance Steel, the AutoCAD-based 3D steelwork modelling, detailing and material listing system, helped structural steelwork company Hawk Structures create an iconic new wing for the Royal Navy Submarine Museum in Hampshire.

The Royal Navy Submarine Museum, based in Gosport, Hampshire, preserves and promotes the history of this important part of the fleet. The museum recently acquired a new wing to house the historic X-craft mini-submarine HMSX24 as well as accommodating information areas, a reception, lecture/corporate entertainment area and a 'Submarine and Sciences' gallery.

Located opposite another iconic structure - The Spinnaker Tower - the project was high profile and formed part of a £3.1 million major expansion of the museum, which included a Heritage Lottery Fund award of nearly £2 million. The new John Fieldhouse Building is named after the late Admiral of the Fleet, Lord John Fieldhouse of Gosport – the most senior submariner in history.

This Advance Steel project provided its own unique set of challenges, and once the architect and engineer's design was viewed it was up to Hawk Structures, a structural steelwork company, with Design & Build capabilities, to ensure the steel structure delivered on all fronts.

Modelling the structure

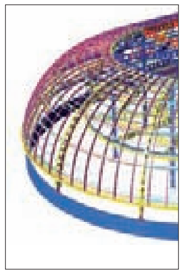
The first challenge in detailing the structural steelwork for the museum was the shape, which was designed to mimic the form of a submarine, including a conning tower. John Bennett, Advance Steel CAD Manager of Hawk Structures was tasked with detailing the steelwork, and brought his experience from working on similar structures using 3D models, as well as his Advance Steel expertise to bear on the project.

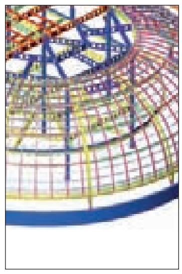
From the engineer's conceptual drawings, the first task was to develop a model of the main structure in Advance Steel. This would help anticipate any problems and prove the concept. With a curved structure such as this the outer skin steelwork must be bent in two directions, so to achieve the correct shape John twisted and rotated each of the twenty building ribs at its own angle. The model was numbered for drawing production, with any changes to it also automatically updating the drawings themselves. When John required help he was able to contact the Advance Steel product experts at CADS, the UK reseller of Advance Steel, who provided tips on working with curve generation amongst other items. Three separate plates were made for the main beams, to allow for either in-house, or as eventually chosen, Fabsec beams. However, the curved beams were eventually supplied by Barnshaw.

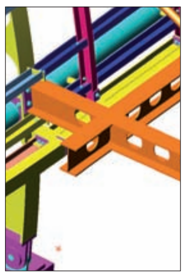
Interior design

The interior specification added some very precise requirements, including creating the impression of a submarine interior. Using curved cellular style beams the architect and engineer had created the ribs and tubular look associated with a submarine. Whilst using cellular beams was not innovative in itself, the fact they needed to be a decorative feature and bent to a steep curve required a new approach. Therefore, rather than use an existing cellular beam, heavier standard universal beams were rolled and formed, with holes profiled and cut by Barnshaw to mimic a cellular beam. Firstly, the apertures were spaced for the best aesthetic effect, ensuring that when constructed the holes looked uniform, regardless of the impact of other structural connections and interior items. These adapted universal beams then needed to be bent beyond the known tolerances of existing cellular beams, without any distortion or kinking of the apertures.

The secondary structure (outer skin) presented more challenges, driven by the client's exacting requirements. This consisted of a base of marine ply nailed to the steel framework, then foam insulation with metal cladding on the outside. A glass wall also runs around approximately two thirds of the side of the building. Special details at the end of beams and weld details were all incorporated in the final solution, with items such as individual stainless steel pins drawn in to the model. The outer skin had approximately 800 pieces that had to be put in by hand.







Open for business

The Royal Navy Submarine Museum's new John Fieldhouse Building was formally opened by Her Royal Highness The Princess Royal in 2005. Before unveiling a plaque to mark the official opening, The Princess Royal described the building as a "very fine memorial to a great man".

Hawk bought AutoCAD and Advance Steel in March 2000, before which material lists were all manually written. The Royal Navy submarine Museum project highlighted a number of important advantages for Hawk Structures about Advance Steel. One of these was the ease with which information can be extracted from the model and imported into an Excel document to aid project management. This was not the case with the management functions of other rival software they were aware of.

CADS continue to provide expert help via its Support team including recent guidance for Hawk to bring its manual material list system together with its models, enabling a material list to be rapidly created. Hawk Structures has leveraged the experience gained on the Royal Navy Submarine Museum. The company now operate four Advance Steel licences and is able to tender for sophisticated projects that go well beyond your average portal frame.

Hawk also operates several software licences for CADS A3D MAX, Smart Portal and Smart Engineer – 'Calc-Pad' type software and CADS Steelwork Member Connections.

Hawk Structures Technical Director, John Salter commented "Choosing and training our draftsmen for Advance Steel was all the easier because of previous AutoCAD experience and/or attendance at a local training college combined with using AutoCAD on the job." Hawk's detailers have received AutoCAD and Advance Steel training from CADS, both on site and at CADS Broadstone headquarters. "Training is essential", says John Salter, "without it we simply would not have made the progress necessary to achieve a return on our investment. After each CADS course our detailers returned to their work with more knowledge and expertise and renewed enthusiasm."

Architect: *Robert Warren*

Engineer: *Samuel Ellis*

www.hawkstructures.co.uk

www.cads.co.uk



It's all in the details

For those that have purchased AutoCAD Revit Building Series, the temptation is to continue to use AutoCAD for fabrication detailing, but CADline's Paul Woddy has long given up on AutoCAD in favour of the intelligence and speed of Revit.

Early editions of Revit did not hold construction detailing as a major selling point (long-term Revit users may spot a slight understatement there!) and during the early adoption phase of the software I regularly fell back on a decade of AutoCAD experience when it came to the nitty-gritty of getting fabrication drawings finished within a time frame. This opinion is now somewhat out of date, but the principle of using AutoCAD alongside Revit is far from obsolete, especially with the almost universal practice of purchasing Revit in the form of Autodesk AutoCAD Revit Building Series - Revit and AutoCAD bundled together in the same box, providing each desktop with access to both applications under the same license.

One reason for Autodesk providing this bundle option at such a competitive price is to present an easy transition path to Revit for those that are perhaps reluctant to face the downtime associated with a software learning curve; something to fall back on whilst getting up to speed.

In practice, we tend to advise all of our customers buying Revit to opt for the series for a number of reasons. Firstly, it has to be a strong argument to suggest switching software platforms in the advanced stages of an ongoing project or in the reviewing, tweaking and updating of archived projects. Secondly, the deployment of Revit across a team usually means that its use is initially restricted to key individuals in the concept and design development process.

Working with DWGs

As the project enters Stages D and E with a potentially larger team of draughtsmen it can be deemed prudent to switch to AutoCAD in order to make use of the abundance of DWG-based knowledge on the market which, when considered along with the relatively low cost of AutoCAD LT means that a large team of detailers need not be trained in new technology in order to get the project detailed and finalised for a relatively low cost. The added factor of training a potentially transient workforce gives further credence to this argument.

Even if the detailing is being generated externally in AutoCAD or LT, the basis for the details originate with 3D Revit geometry and the completed details can be imported back into Revit to co-ordinate the finished drawing set. Bearing all of the above in mind, our implementation plan will more often than not include a gradual deployment of Revit starting in the conceptual design space and working out to publication. We tackle the fear factor head-on by demonstrating that an efficient jump to AutoCAD can be initiated at any stage without major issues or rework, the team therefore feel more comfortable pushing Revit further forward in the project. Over a very short period, user confidence in own ability grows and the switch to AutoCAD becomes less and less appealing or required.

That said, the use of legacy data, even on an elemental basis will continue for a long time. Almost all practices have access to a library, built over many years, of pre-defined details or common arrangements of element groups that form the basis of detailing. Furthermore manufacturers often produce DWG details of their catalogue of components for use in CAD. Either way, this information can still be used inside Revit, without having to rework or redraw the linework.

What this means is that I can use a very simplistic one-size-fits-all window for my 3D and GA views whilst in the section or callout, where I need to see more accurate information, I simply turn off the visibility of the Revit window and import the anatomically correct detail. On the finished result, you cannot distinguish between the Revit and the DWG linework. In the long-term, importing the DWG information directly into the simplistic window component means that every time you cut a section through an instance of that window, you will see the more detailed version. The result being a library of very simple geometry, with an abundance of useful tabular data for schedule purposes attached, along with an accurate detail view.

Detailing in Revit

Revit is now more than capable of fabrication detailing and I have long since given up on AutoCAD in favour of the intelligence and speed of Revit. At this point, let me explain the idea of detailing, the Revit way. Revit is used to generate a digital prototype of the building, assimilating the real-world scenario as closely as possible and the software is capable of taking this theory to the nth degree, which is not always efficient in terms of time and hardware power. The mantra that I teach in deploying Revit is a simple one:

"Model as simply as you can get away with; Detail as much as you need."

In practice, this means that 3D modelling to a GA stage is practical and speedy, whilst beyond 1:100 or 1:50 we are in danger of getting bogged-down with unnecessary 3D modelling and hence losing all the advantages so far realised in using Revit. To this end, the detailing functions of Revit allow view-specific 2D cosmetic patches to be quickly and easily applied over the top of the 3D geometry.

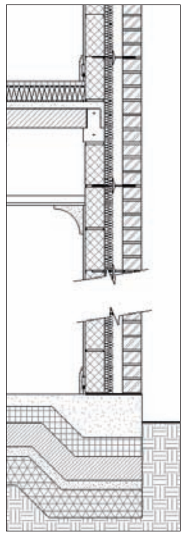


Figure 1: *Rather than model the sweep of the skirting boards and other mouldings throughout a building, the profile of the moulding is applied as a 2D detail in the small number of relevant views.*

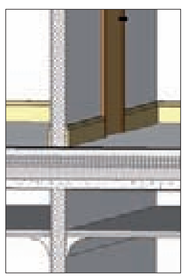


Figure 2: *The skirting and coving mouldings in this example are attractive to look at in 3D, but unlikely to provide a return on the investment in time it takes to model them throughout a building. Modelling to this level of detail should be carried out only where isometric or perspective camera angles require it.*

The tools at hand...

In the example in Figure 1, a section has been cut through the model to show a section of wall. The composition of the wall and floors is displayed to us simply as thicknesses of materials as shown in Figure 2. Rather than model the sweep of the skirting boards and other mouldings throughout a building, the profile is applied as a 2D detail in relevant views.

Coursing information and other recurring patterns are applied using a repeating detail tool, whereby the detail component of a 'brick with mortar joint' for instance is repeated at 75mm intervals along a sketched line, traced up the edge of the brick element in the wall composition. The same technique takes care of block-work, wall ties and the beam & block flooring.

The thickening of the slab shown at the base of this example is entirely a 2D alteration to the graphics of the 3D slab of constant thickness. Add to this automated keynoting, text, dimensions, filled regions (hatching) and good old-fashioned lines, arcs and circles and you have a pretty effective draughting tool and because we are not starting from a blank sheet approach, the time to produce the detailing is considerably reduced.

The downside to 2D modification is that we are potentially breaking the co-ordination link of the data and that our sections and call-outs no longer reflect the same data as the 3D model and schedules, hence the coverall nature of the above mantra in using the phrase "simply as you can get away with". In the case of the thickened floor slab for instance, the volume of concrete required will not increase to accommodate the extra material required. If you need to show it in 3D or in a schedule then perhaps you can't get away without modelling the item. Of course the counter argument to this is that schedules can derive more information through calculated fields than is initially obvious.

The bottom line is that there are no hard and fast rules, but rather there is a choice to make between accurate modelling and hence accurate scheduling or the quicker but usually more efficient method of employing 2D draughting where we can, combined with an acceptable inefficiency in the schedules. It usually comes down to a corporate guideline with exceptions for given scenarios. Let me change that slightly. There are no hard and fast rules bar one;

The method that gets the job you get paid for, done in the shortest time frame is the right one. If, along the way, the quality of your output improves, then that's even better.

www.cadline.co.uk

Gallery

The latest architectural design visualisation projects

Designhive

Project: Khabary, Fahaheel, Kuwait

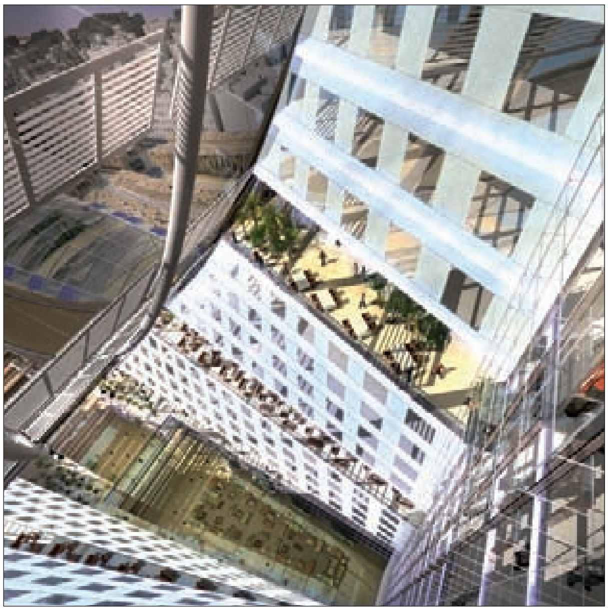
This proposal for a futuristic self contained city, located in Fahaheel just outside of Kuwait City, incorporates just about every bit of infrastructure you could dream of, ranging from hotels, retail, and residential units, to leisure facilities, hospitals and educational establishments. The pioneering 32-storey design, which pushes the boundaries of modernism, also features an undercover walkway designed with new technology to keep temperature cool and stretches from one side of the city to the other.

Designhive, an architectural visualisation agency based in Surrey & Central London, was brought on board to create the branding identity of the city and create a series of stills and animations to present to the government of Kuwait and potential investors. The company's designers, all of which have architectural and interior design backgrounds, developed the visualisations inside 3ds Max using a mixture of information supplied by the original architects including 2D CAD drawings, hand drawn sketches, and 3D concept models. The VRay lighting plug-in was utilised to produce realistic lighting effects. Texture-based mapping was used to reduce the polygon count in animations and speed up render time on its 60 processor render farm.

"It was important for the client that the animations were of the same quality as the stills produced and we achieved this on the project using 'Combustion' to composite layers within a sequence of rendered frames," says Janine Tijou, Director of Designhive. "We also composited the model into live aerial footage using a program called Boujou. We've been using this product for the last three or four years and it's becoming a much sought after commodity in our industry having buildings shown in context."

"It is an honour to have been such an important part of an incredibly pioneering project like Khabary," concludes Janine. "We revelled in the fact that the requirements of this project pushed us and we rose to the challenge with relish; the end result is one which presents Khabary as a future city with vibrant community and many economic reasons to justify the scheme. It's a powerful set of dual language animations. ***www.designhive.co.uk***













DeJong Design Associates

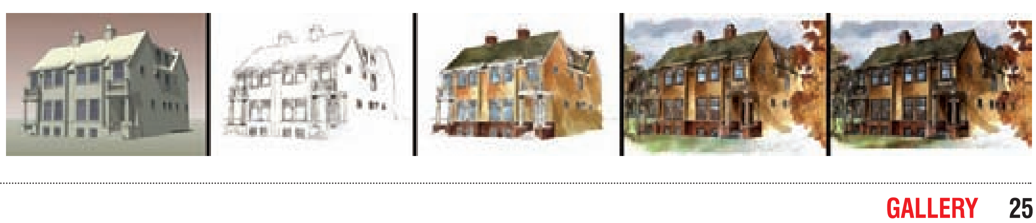
DeJong Design Associates is a residential architectural design firm located in Calgary, Alberta that focuses on inner city and vacation properties. Through SketchUp, DeJong imports a flat 2D AutoCAD drawing and builds 3D impression of the residence. Piranesi is then used as the catalyst, allowing for an increased spectrum of artistic creativity.

"Most rendering software creates a hard computerized graphic, straying from the traditional architectural rendering," says David A.Walker, Dejong Design Associates. "However we've found that Piranesi stays true to the masterful representation in this particular industry that has always been so appealing. The usage of Piranesi's controls and tools allows us to achieve a rendering that truly feels and looks like a hand-rendered impression." ***www.dejongdesign.com***









Autodesk Design Review

Autodesk has, yet again, reworked and re-branded its viewing and mark-up solutions for AutoCAD, Revit and Inventor. Autodesk Design Review is the company's new top end design collaboration tool.

It's safe to say that Autodesk's viewing, redline and mark-up strategy has gone through a number of iterations in recent years. At times it has cost money to have an Autodesk application that just viewed DWG files, at other times it has been free. More recently the only free application was a DWF viewer and users had to pay for an integrated DWG viewer and mark-up solution. Over the years there have been a number of branded products: View, Volo, Composer and now Design Review. DWG viewing outside of AutoCAD has been a moveable target and quite confusing for customers.

There are a number of reasons for this confusion - the main one being Autodesk's re-emphasis on its DWF format (Design Web Format) for information exchange. DWF is a very lightweight 2D and 3D format for communicating and securely collaborating with extended teams. DWGs can get quite large and sending them over the Internet can be problematic. There's also the issue of sending your intellectual property outside of your company in an easily editable and 'copyable' format. Growing numbers of users are opting to send drawings and models by the Internet and there is generally more interest in formats that allow collaboration.

However, Autodesk's competition have also kept Autodesk on its toes. Viewing of DWGs is now pretty much free with or without Autodesk's efforts. Indeed, Autodesk's competition, Bentley and SolidWorks to name but two, have ensured that they offer free DWG viewing applications to fill the gap that Autodesk left when it removed its free DWG viewer a few years ago.

It seems in part response to these efforts that Autodesk is once again offering a free (around 100Mb) downloadable DWG viewing capability, called Autodesk DWG TrueView. This is a stand alone product but also plays a role in its paid for Design Review product, Autodesk Design Review, which has evolved from Volo View with some substantial improvements.

The good news is that Autodesk appears to have developed a scalable range of pretty competitive DWF and DWG offerings, despite the potential confusion of the new branding.

Design Review

Before delving into what is Design Review, it's probably best to position it against its free little brother Autodesk DWF Viewer, which is a subset of Design Review. The free-to-download DWF Viewer supports the viewing and printing of files saved in the DWF format.

One thing that's a bit annoying about the free DWF Viewer is that it has a built in advert bar, which, even though small and mainly advertising Design Review, starts to get on your nerves over time.

Design Review adds mark-up, measure and annotation, together with 'out of the box' support for DWG, DXF and Inventor as it comes with Autodesk's 'DWG TrueView' engine. DWG, Inventor and DXF files can still be viewed for free by downloading the sizeable DWG TrueView product, but I guess the benefit of Design Review is that all this functionality is integrated into one product.

After loading, the first thing you notice about Design Review is its clean interface. There's a big display area on the right, with a document navigation bar on the left including details such as multi-sheet info, mark-ups, properties, layers, views, cross sections and animations. These all fold up and expand in an accordion style, providing a quick and easy way to navigate through the contents of a file, while looking at the image on the right.

Of course there are a few tool bars of icons: open, print, select, pan, zoom, zoom window, 3D rotate, section, and pull apart etc. Then there are a number of

animation tools. There are pull downs too for those that prefer that way of working.

Within the display area, the mouse is context sensitive, so if you first select an object in the model/drawing then right click you get a selection of functions. However without anything selected you get a slightly different set of general options.

When you load a 3D DWF for the first time I have to say how beautiful the rendering technology is in Design Review. There's a really nice look and feel to the shaded parts and it looks similar to, (perhaps unsurprisingly) Inventor's slick graphic output. There are a number of options to use see-through materials and change the render properties of the global environment or individual parts. It's a really great environment to create graphics, stills and animations for explaining how an assembly works or is put together.

The Sectioning tool is an obvious boon to doing this and it's really easy to use. A plane can appear in either XY section, YZ section, XZ section or selected by surface orientation, then by selecting the red green and blue XYZ axis you simply move or rotate the slice. These sections can be saved for quick access from the side menu. There are a number of useful options to display the sectioned area to make the edges more visible.

Obviously one of the big benefits of buying Design View is that you get full mark-up and annotation tools. These work on both 2D and 3D files, including the new 3D DWF. You can add coloured highlights and pointers to the workspace, with text explaining why something should be looked at or altered. Again all these are saved within the file and accessible from the side menu. When brought back into AutoCAD (or many other Autodesk applications), these 2D comments can be seen and changes made to the original file in the originator's CAD system. These changes can be tracked within each drawing, as it stores a history of the changes. There are nine mark up tools for annotation, varying clouds and pointers, all are easy to insert and smart to edit and place. To Measure there's a tool palette on-hand to measure some basic lengths, angles, edges, radii etc. The cursor automatically snaps to the geometry of the model as you move the cursor over the lines, these can be stored as mark-ups or deleted, if you were only just checking the dimensions.

It's also possible to stamp a drawing with one of its seven 'stamps'; approved, rejected, not to scale etc. These can be created and imported though DWF.

Most Engineering projects require documents from various applications to be combined together. Design Review allows information to be brought together in a single DWF, which could contain 2D plans, 3D models, Bill Of Materials, Word Documents, Microsoft Project pages etc. Here you can 'capture' on-screen information using a snapshot tool, which grabs windows application data and adds it to the DWF. These documents can, of course be reordered and renamed.

It's clear that Autodesk is aiming Design Review at those that want to loop data around a team to round-trip the information, gathering input along the way, while being secure (can be password protected), in that it doesn't alter the original information. DWF is designed to be the wrapper for the project data as it gets sent around an extended or small enterprise, in an iterative design process.

I think with this product set, Design Review and DWF demonstrates exactly why people should start thinking of using 'skinny' DWF instead of full-fat DWGs around the world.

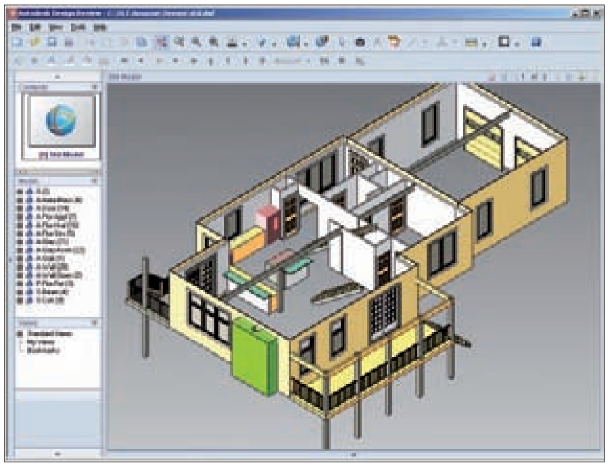
Conclusion

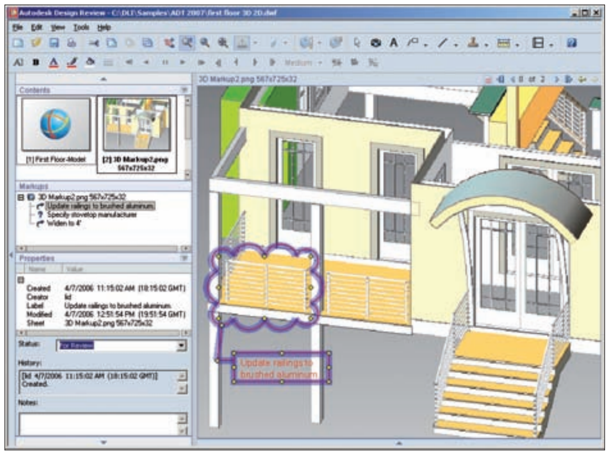
Autodesk Design Review is an excellent View and Mark-up tool for people working within AutoCAD, Inventor or Revit-centric workflows. As you'd expect, as Autodesk knows its formats like no others, it's been able to build in very tightly to the core applications, the redlining round-tripping and sheet-set support being the most obvious benefits of this.

The interface, performance and ease of use also add to the positive experience and DWF is extremely impressive at being able to compact data. I guess it's a given for Autodesk products like Inventor and AutoCAD but using the stand alone Autodesk DWF Writer, you can create, in one click, DWF files of Microsoft Office documents, and these are tiny in comparison to PDFs.

However, as it's an Autodesk product, it's not a multi-CAD format viewing tool like Cimmetry AutoVue or Actify SpinFire, which are useful whatever CAD application created the files, Design Review does Autodesk formats. A number of these multi-format vendors have added DWF to their array of formats supported.

Autodesk has also developed DWF plug-ins for SolidWorks, Pro/Engineer and Catia, so there's a chance you may be able to convince someone who's working using those tools to download the DWF add-on and send you files in a format that Design Review can handle.





It's interesting to see the development of DWF start to take off on its own direction. Rather than just being a dumb file to send to people to look at, Autodesk is adding more and more intelligence to the files, so it will be actually possible to query and extract engineering information from the DWF. DWF is becoming more like DWG-lite. With a developers' program underway and applications shipping, expect to see applications built around DWF, such as Facilities Management (FM), Commerce applications, BOM extractors and schedulers.

The free version of DWF Viewer is a good way to explore the capabilities of DWF and the Autodesk viewing environment. By buying Design Review, you'll also get the data security, mark-up, annotate, tracking and 3D cross sectioning, amongst other things.

www.autodesk.com/designreview

3D CAD speeds rail design

One of the largest infrastructure projects ever undertaken in the Netherlands is on track for completion in 2007. Cees Veerhoek explains how 3D CAD was used during the construction.

The 160-kilometre Betuweroute double-track rail line - with a design speed of 120 km per hour and an axle load maximum of 25 tonnes - links the Dutch city of Rotterdam with Zevenaar on the Dutch-German border. It is the first rail track in the Netherlands dedicated to the transport of goods, carrying freight from one of the world's largest ports to the continent's interior.

The rail line will decrease traffic on the motorways, and is expected to triple yearly revenues of goods traffic by train from the Netherlands to other European countries.

The €4.8 billion Betuweroute project was started in 1991 and entailed an upgrade to the existing port/rail track as well as the construction of a new track. The project also entailed creating a new freight yard at Maasvlakte, adapting the marshalling yard at Kijfhoek, and realising a Container Interchange Point near Valburg. An important design requirement for the new construction was to preserve the landscape as much as possible. As a result, the whole line had to be situated over a length of 95 km parallel to the A15 motorway. For this reason, 60% or more of the A15 motorway in the Province of Gelderland had to be relocated.

As a point of principle, the Betuweroute and the A15 motorway had to remain at surface level as much as possible and the intersecting infrastructure had to be guided over it, which was a drastic operation. At least 14 interchanges and several motorway junctions had to be changed. The most important key challenges were the realisation of 7.5 km track built underground with deepened lines, five tunnels with a length of 18 km (including three bored tunnels), 130 viaducts/bridges with a total length of

12 km, 140 km of noise barriers, 5,600 overhead gantries, 600,000 sleepers, and 190 fauna passages to enable animals to safely cross under the rail lines.

The Betuweroute and the redesign of the A15 motorway were completely designed in 3D, which provided important insight into spatial occupation as well as accurate calculations of ground quantities. Among the many project design challenges were the alignment of connecting arcs with existing track, design modification to motorways that crossed the new track, and collaboration with many local authorities. Also, the required earthworks, phased during the implementation of the work, were modelled and used throughout the whole project for generating output data and quality control.

Presenting alternatives

On behalf of the Dutch Railway Authority (Managementgroup Betuweroute), the consortium of



two Dutch engineering companies formed specifically for the project - VOF Grontmij-De Weger - delivered the Betuweroute design from Rotterdam to the German border (120 km). VOF Grontmij had the responsibility of explaining the different alternatives, including below-grade lines, and tunnels from both an environmental and cost perspective. Part of the challenge arose from the fact that most of the people in the involved municipalities were not familiar with engineering and would have had a great deal of difficulty understanding traditional 2D drawings.

The Betuweroute largely passes through populated areas, and each of the municipalities representing those communities in the rail line's path had concerns about noise, air pollution, and visual appearance. In many cases, the municipalities asked the designers to make changes to the rail design, and then asked to see how the track would look after their changes had been implemented. Use of a 3D model significantly shortened the time required to complete all of these changes. Reason: After the model has been changed, it could be used to easily and quickly update all of the related documentation.

Many of the local municipalities wanted to put the track below ground level, and if they all had had their way, the cost of the project would have exploded. So VOF Grontmij rendered the 3D model and created visualisations from the point of the view of the inhabitants near the track, drivers on a nearby road, and the conductor on the train in order to show the municipalities exactly what VOF Grontmij's proposal would look like. These visualisations were so realistic that the officials had no difficulty understanding them. In most cases, the models convinced them that the consortium's solutions would be acceptable. As a result, only three sections of tunnels, with a total length of about 25km, were required, saving hundreds of millions of euros.

The 3D design methods also simplified the task of aligning the route of the track across the Dutch landscape. The 3D model made it much easier to evaluate alternative routes in relation to considerations such as connecting arcs with existing track, adapting to roads that crossed the track, developing the appropriate grade for tunnels, calculating the amount of earth that needed to be moved during construction, and determining the exact amount of space occupied by the right-of-way. It was possible to change long, complicated sections of a complete junction - including the generation of all necessary

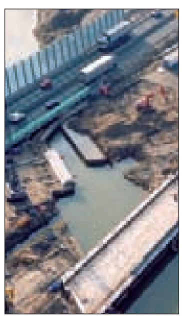


work drawings - in a few hours vs. the days that would have been required to redo many drawings using conventional 2D methods.

3D CAD in large projects

VOF Grontmij-De Weger began using Bentley MxRoad (MOSS) back in the mid-1980s because the company recognised - much earlier than most other design firms - the potential for 3D CAD to improve both the design process and communication with stakeholders. VOF Grontmij originally selected MxRoad because it was the only software package that made it practical to develop large projects fully in 3D. Since that time, the competitive landscape has changed considerably and there are many more alternatives, but MxRoad is still by far the best choice for larger projects.

Producing the design in 3D dramatically simplified collaboration and significantly impacted workgroup productivity. Multiple people from different disciplines, all of whom were required to meet the project's tight timeline, could simultaneously access project files. Each person worked independently, yet everyone's work was referenced in the master model. In other words, each team member had view-only access to the



entire model so he or she could easily see the work of others in relation to his or her own.

The use of standards such as string labelling, model name conventions, and input files maintained consistency between the various designers' work.

Eight years may seem like a long time to design a railway, but considering the magnitude of the project, it was remarkable that VOF Grontmij was able to finish the project on time. Throughout the course of the project, the company designed every section of the line a minimum of nine times. MxRoad made it possible for VOF Grontmij to adapt to the changing requirements and opinions of the project stakeholders almost as fast as they could express them. And MxRoad's powerful visualisation tools helped VOF Grontmij clearly communicate the impact of various alternatives. The company does not know of any other software package that could have provided these important capabilities.

Cees Veerhoek is Manager for the VOF Grontmij Rail Department.

This article first appeared in the April 2006 edition of GEOconnexion International Magazine.

www.bentley.com

Matching site data to MasterMap

The recent launch of OS Net brings real time kinematic (RTK) GPS to the field and site surveyor and centimetre level positioning. But what does this mean to those in the construction industry?

Previous articles have focused on exploiting and integrating existing detailed digital mapping in your GIS and CAD applications. Most CAD and GIS users work with and around or actually also carry out site surveys. Many are thus aware of the potential errors in such data and what needs to be done to eliminate or remove the different types of error.

The advent of GPS technology in the 1980s, combined with the ever shrinking size of the equipment and corresponding increase in performance and processing power, brought centimetre accuracy to the desktop and, for those prepared to invest, to the top end of the profession. The recent launch of OS Net as an adjunct to all Ordnance Survey's other data capture and distribution capabilities now brings real time kinematic (RTK) GPS to the field and site surveyor where previously only differential GPS (dGPS) existed. This article explores what this might mean to the readership.

What is OS Net?

GPS technology has changed and continues to inform the way we understand our position and the way we do things. It's a technology now enjoyed by almost everyone in Great Britain (in some way or another) but GPS as it currently stands only delivers positional accuracy to around 10m or more. OS Net takes raw GPS data and through building complex error models can provide real-time centimetre level positioning to those with the appropriate equipment.

OS Net is a national GPS infrastructure and service developed by Ordnance Survey to provide up to 1cm accuracy real-time positioning to the map base (and thus to OS MasterMap). OS Net is not directly available in the marketplace (**see later**) but should be seen as the enabling technology that serves application markets via the services that Ordnance Survey partners build on top of OS Net.

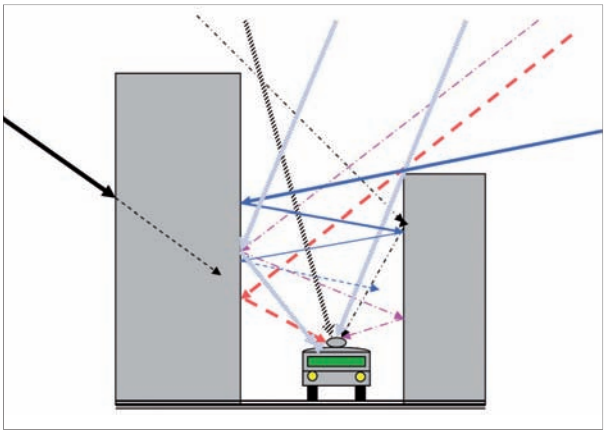


Figure 2: *GPS signals deteriorate quite easily in certain environments.*



Figure 1: *Positional accuracy varies between different GPS systems*

As a nationally consistent source of position referencing, OS Net implicitly supports local and national applications that require a positioning element enabling quicker and easier positioning and the use of a common coordinate system.

The network is made up of more than 90 permanent GPS base stations at a density that enables RTK positioning services across most of the country. From the observations made by these stations errors can be calculated in the GPS system to provide a range of correction services that seek to rectify the majority of errors caused by the satellite orbits, clocks and the atmosphere.

For the technically minded it is worth noting that RTK initialisation time is less than a minute, with RTK rmse (root mean squares error, the standard mechanism of error measurement) horizontal accuracy being 1-2cm and vertical accuracy 3cm with a precision of less than 1cm. Pre-launch tests revealed that 95% of the 2D error vectors are $<=$ 35mm and 95% of the height errors are $<=$ 65mm. Also, the accuracy of test points on the outside of the network of base stations or in sparse regions was seen to be negligible. OS Net also includes dGPS services whose positioning accuracy is sub-metre (down to about 20cm). **Figure 1** illustrates what this means…

What does OS Net enable?

Unsurprisingly perhaps, the base station network has been providing centimetric level positioning service for Ordnance Survey surveyors; this should mean that new data reaches Ordnance Survey databases faster, delivering efficiency and flexibility.

OS Net as a service is not available commercially, however, the reason this is now of relevance to users is that Ordnance Survey has commodotised the service to allow partners to utilise this network data to develop and provide a basket of real-time and post-process GPS correction services from 20mm upwards to customers within a wide range of markets.

Ordnance Survey will maintain the accuracy and quality of geodetic calculation within the network, while partners will in the same way as Ordnance Survey does, use advanced software tools to create models of GPS errors. Once these errors are known, corrections can be calculated and then services transmitted to customers or their contractors in the field to improve their positional accuracy.

Ordnance Survey has already reached agreement with at least two major survey equipment manufacturers to enable them to license OS Net. At the moment this is done on a per device basis so that users request the appropriate software post-processing module. This is a revenue opportunity for Ordnance Survey and its partners and one that brings real productivity benefits to users:

- single person operation
- quicker, easier correction available almost anywhere
- reduced hardware costs (only one receiver required, no base station)
- faster set up
- adoption of a common coordinate system (the official name of this is ETRS89)
- direct linkage through the licensed service to GB National Grid and the Ordnance Survey height datum via OSTN02 and OSGM02.

Licensing of RTK GPS correction services changes the way surveying is carried out, increasing the value of the surveyor and offering up a more flexible and efficient data capture environment.

Certain users, for example those developing new applications, the Met Office and academics are able to register for access to these services. And for others Ordnance Survey continues to offer a free service for post-process applications maintained (using readings every 30 seconds for correction to the national coordinate reference frame) from **www.ordnancesurvey.co.uk/gps.**

What doesn't it change?

Leisure and some other users of GPS labour under the misapprehension that GPS is always precise and accurate (and many don't know the difference but that's another story!). In fact GPS signals deteriorate quite easily in certain environments, notably urban canyons and under vegetative cover (and under water without an antenna!).

Figure 2 illustrates the problem and users should

be aware that while OS Net can improve the position you get from your GPS, but it doesn't help you get a position / get more satellites! A similar situation occurs in forested and wooded areas, one that can in part be resolved by fixing an antenna to a telescopic device.

Potential Applications

You won't need this article to spell out the obvious ones in the construction industry but a few tangential ones are worth mentioning:

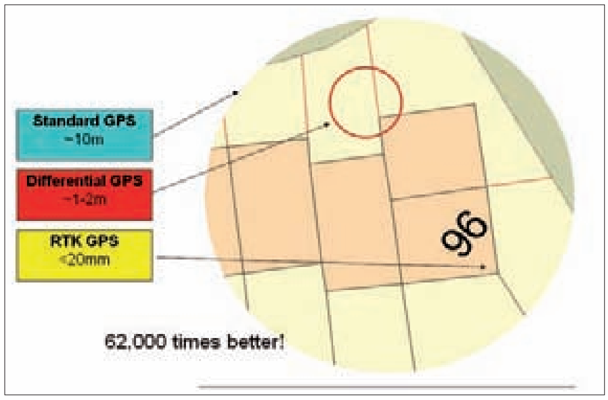
- Underground assets/utilities – where OS Net has been used, utility networks will be very accurately positioned in three dimensions and thus should come more cheaply and easily constructed and maintained (lower works costs, interoperability with other networks owing to use of ETRS89)
- Port activities – OS Net can help in near-shore pilotage, vehicle tracking and container location
- Machine automation – adoption of OS Net for vehicle tracking in agriculture, earth works, terra-forming, coastal defence creation will decrease direct (fuel/maintenance) costs, reduce resource waste (e.g. over spraying), reduce carbon footprint and other environmental impacts
- Event and asset records – street furniture, flora/fauna observations, track and roadside assets, accidents, incidents, emergencies, evidence gathering (from police checks to street fouling)
- VISTA - The DTI funded Vista Project (visualising integrated information on buried assets to reduce street works) looks to develop methods to bring together utility asset records and link them to new surveys. Technologies like GPS will play a key role in locating and relocating these assets.

And the Future…

The future of satellite navigation could mean that there are 60 to 80 usable positioning satellites in orbit by 2012, compared to the current crop of about 24 GPS satellites. This will mean much better availability in built-up areas as well as quicker and more accurate positioning. These extra satellites come from two sources:

- Galileo is the new European satellite system, which is due to launch up to 30 satellites from 2008 to 2010.
- GLONASS is the Russian equivalent of GPS. There are currently nine working GLONASS satellites in orbit; new funding could mean that this is increased to 24.

Once dual GPS/Galileo receivers are fully available and Galileo satellites are starting to be launched, Ordnance Survey will plan to replace the OS Net base station infrastructure with GPS/Galileo receivers. These receivers may also be able to receive GLONASS signals. This is planned to happen in late 2006-07 and will mean that OS Net is able to generate corrections for whatever type of receiver a user has. A second re-equipping of the GNSS (Global Navigation Satellite System, generic term for GPS, Galileo et



al) infrastructure will probably occur in about 2013, but it is seen that there will be little change to the functionality of the receivers and the end-products that they could offer.

For those of you wondering why Ordnance Survey bothered with OS Net when Galileo and EGNOS (an advanced differential GPS service using geostationary satellites already built into many receivers) were slowly creeping over the horizon then the reality is that the infrastructure being marketed as OS Net was already a key enabler for Ordnance Survey themselves and that in bringing it to market the best interests of users and of joined up government can begin to be served immediately.

This article was written by James Cutler, CEO at eMapSite, a platinum partner of Ordnance Survey and online mapping service to professional users

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Intel Core 2 Duo: Woodcrest

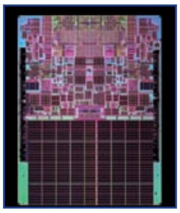
Intel's next generation Xeon processor, the 5100 series, has arrived. Codenamed Woodcrest and based on the much hyped Core 2 Duo processor, Intel finally has the chip to take the fight to AMD, says Greg Corke.

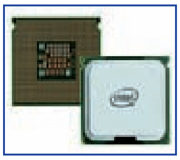
Intel has spent the last few years playing second fiddle to AMD in the workstation benchmark charts. After a lengthy time in the wilderness AMD finally earned its spurs in the workstation space following the excellent performance and scalability of its Opteron processor.

It was the specialist System Integrators that first acknowledged the potential of the Opteron, and following on from this the major workstation OEMs couldn't afford to ignore AMD's 64-bit processor any longer. Demand by power hungry CAD/CAM/CAE and DCC users was just too strong. As a result, Fujitsu Siemens and IBM added Opteron-based machines to their workstation families in 2004, and HP followed soon after. Today, the only OEM not to offer AMD's Opteron in its workstations is Dell.

With the sudden widespread availability of Opteron in the workstation sector, Intel took a knock, particularly at the high-end, and needed to respond with some cracking technology. For months the industry has been talking about Intel's next generation processor, and with its new Core 2 Duo-based Xeon processor out now, the California chip giant has certainly got something to shout about.

Codenamed Woodcrest, the Xeon 5100 series is the workstation/server specific chip from the Core 2 Duo family, a new generation of desktop processors from Intel. Core 2 Duo marks the first major architectural change that Intel has implemented since the turn of the millennium. Out goes 'Netburst', which arrived with the Pentium 4, from here on in it's all about the new 'Core' architecture.







What about Dempsey?

Some readers may have heard of a new Intel chip codenamed Dempsey which was launched in May this year under the Xeon 5000 series brand. This processor is the predecessor to the Xeon 5100 series and is based on Intel's older 'Netburst' technology and not the new 'Core' architecture. The 5000 series runs at clock speeds ranging from 2.67GHz to 3.73GHz, and features hyperthreading unlike Woodcrest. While we haven't seen any 5000 series Xeons in action, it has been reported that the processor is not as fast or energy efficient as Woodcrest. Indeed, a Xeon 5160, which runs at 3.0GHz and is rated at 80W, is faster than a Xeon 5080, which runs at 3.73GHz, and is rated at 130W.

So why has Intel launched two entirely different product lines within a month of each other, particularly when the 5100 series is the better CPU? Admittedly, this is still a bit of a puzzle, but it's been reported that Intel's manufacturing guys managed to pull Woodcrest in ahead of schedule. As a result, both Xeons are on sale in most OEM's workstation lineups, but with Woodcrest performing so well and at low wattage, there seems little incentive to buy into Dempsey.

So what exactly is the new Core 2 Duo-based Xeon chip? The Woodrest Xeon features a shorter pipeline, and boasts 4MB of on-die L2 cache, which is shared between the two cores, and means it can assign a single CPU the full 4MB if required. The Xeon 5100 series also features a lightning fast 1,333MHz Front Side Bus (FSB) in all but the low-end Xeons. Naturally, there is support for Intel's EM64T technology, meaning it can run both 32-bit and 64-bit Windows and applications.

The Xeon 5100 family has a total of six models, ranging from the modest 1.6GHz Xeon 5110, up to the 3.0GHz Xeon 5160. While this apparent drop in GHz from the previous generation Xeon processors will be confusing to many, what it actually means is that Woodcrest is far more efficient at processing per clock cycle. Indeed, our tests show that a 2.66GHz Xeon 5150 is still far faster than a previous generation Xeon running at 3.6GHz.

As Intel's dedicated workstation chip, you can put two Xeon 5100s in a single workstation giving you a total of four cores to cut through multithreaded operations like rendering.

When it comes to backwards compatibility, Woodcrest earns full marks as it comes in the same LGA775 package, which was used for the Pentium 4 and Pentium D, so existing motherboards will be able to accept the new processor, usually following a simple BIOS update.

One technology that is notably absent from Woodcrest is hyperthreading, which transforms each CPU into two logical processors. Hyperthreading was available in Intel's Pentium 4 and older Xeons, but the jury is still out on the technology which only worked well with certain multi-threaded applications, and actually slowed down performance under others.

Energy efficiency

Intel has been slated in recent years for the amount of power its processors draw, and hence the amount of heat they produce. Indeed, this contributed to the success of AMD's Opteron, particularly in blade server environments where cooling can be a major problem. The marketing folk at Intel have naturally been quick to pick up on this and are making big noises about Woodcrest's 'industry leading' power consumption and excellent performance/watt ratio. In addition, like Intel's mobile chips, Woodcrest is able to shut down parts of the processor when not in use, saving further power. .

So what exactly does all this mean? Well quieter workstations for one, as cooling fans don't need to work as hard, but companies can also save a lot of money by reducing power consumption and cutting down on air conditioning costs to combat the amount of heat that high concentrations of workstations produce – and when you look at the wider picture, it's also doing its bit for global warming.

Specifications

Intel Xeon 5100 series model numbers

- Xeon 5160 (3.0GHz, 1,333 MHz FSB)
- Xeon 5150 (2.66GHz, 1,333 MHz FSB)
- Xeon 5140 (2.33GHz, 1,333 MHz FSB)
- Xeon 5130 (2.00GHz, 1,333 MHz FSB)
- Xeon 5120 (1.87GHz, 1,066 MHz FSB)
- Xeon 5110 (1.6GHz 1,066 MHz FSB)

Believe the hype

From our preliminary benchmark tests on Woodcrest, Intel's new workstation processor certainly lives up to the hype. Our Dell Precision 690 test machine which featured two dual 2.66GHz Xeon 5150 processors, set new records in all of our CAD application benchmarks. And let's not forget that Intel still has a faster processor in the Woodcrest family, the Xeon 5160, which runs at 3.0GHz.

Conclusion

With Woodrest, Intel has produced the fastest and coolest processor on the planet, which is destined to become a huge success in the workstation sector. AMD certainly has a fight on its hands and it will be extremely interesting to see how things pan out over the coming months. While Intel's new Xeon 5100 series is certainly revolutionary, AMD's Opteron is currently in an evolutionary phase and it remains to be seen if the addition of DDR2 memory in its new generation 1000 series will be enough to keep its workstation crown.

Looking to the future, both AMD and Intel should have quad core processors ready for early 2007 (or by the end of year, according to some reports), which will put buckets of multiprocessing in the hands of design visualisation users, and then the scalability of AMD's and Intel's architectures will really be put to the test.

www.intel.com

Workstations: keeping it cool

By Rob Jamieson

For CAD, workstation performance is essential, but keeping your machine cool without it sounding like a plane taking off, is also vital.

Summer has arrived and as I sit in my office complaining about the heat (us Brits love to talk about the weather) I'm watching an older workstation gradually slow down as it struggles to exhaust the heat it produces (a bit like the way I'm feeling in a non air-conditioned office). Time for a fan upgrade I think.

Just about every device in a computer produces heat – a side effect of switching devices. The smaller the physical transistors are the less heat they produce and the less power they consume. Modern chips are measured in the size of their production process in nm (nanometres). Smaller switches = less heat and better performance. The current smallest fabrication produces 65nm. As performance and functionality means packing more transistors onto a single chip (dual core, for instance, is packing two cores in one chip) even though the die is getting smaller the complexity is increasing.

This relationship between smallest size, production of heat and wattage consumed has given Intel its new slogan "performance per watt" for the new Xeon processors. This might seem strange when all the design, analysis and CAD users want is ultimate performance but if you have a room full of racks to render images for films then your electricity bill becomes quite important to you as well as air con!



Cooling down

The heat that performance components produce - whether it is CPUs, GPUs or disk drives (mechanical heat producer) etc - has to go somewhere. The standard approach for CPUs and GPUs is to use a highly conductive material (generally metal based for obvious reasons) in a heat sink with air cooled fins backed up with electric fans. These little electric fans can be the cause of a lot of noise in older workstations, and this is something I often hear complaints about.

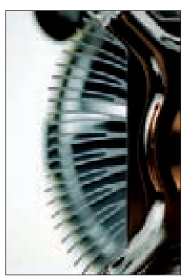
The primary purpose of a fan is heat removal by airflow. If a fan is physically small for packaging reasons then to get the required airflow they need to spin at a high rate, hence the noise. Today fans are designed to be more efficient by being physically larger and spinning slower, whilst still maintaining the required airflow. This airflow throughout the whole case is very important for the system. This is why all the OEMs (Original Equipment Manufacturers), such as Dell and HP, and the SIs (System Integrators), such as CAD2 and Xworks are designing and using special cases to exhaust the hot air. I was looking at the new 690 workstation from Dell the other day and it has separate compartments for CPUs, memory, hard disks and graphics to stop the heat transfer from different components. Likewise, HP uses a thermo fluids package when designing their workstations which models airflow throughout the whole case.

However, don't think that some of the smaller SIs can't deliver quiet systems. SIs have a greater choice of cases to choose from and can fit the latest heat sinks and fans. Some of the first designs for "upside down cases" appeared in SI systems before OEMs even picked up on them.

Originally fans ran at a constant speed but now they have a third wire to adjust the speed. Motherboards and CPUs have heat sensors on them which send signals to the fans. Often when you turn on a workstation the fans kick in at a high speed. This is just in case there has been a forced restart under a high load. Once the temperature sensors have kicked in and registered all is OK then the fan's speed will reduce to normal operation.

Reducing noise

So what can you do if your workstation sounds like a washing machine on a spin cycle? The first thing to do is take it apart and clean out any dust and fluff. If a machine gets clogged up then the fans will need to spin faster to clear the heat which results in more noise. If a fan fails then the other fans increase speed to compensate therefore increasing the total noise further. A lot of systems slow down their processors' "throttle" if they get too hot and you might only know this as the system starts to slow down. Typical fan failures arise because of a stray power cable jamming into the fan blades – which just goes to show you that a well put together workstation with cable control is important and may help prevent unnecessary stoppages.

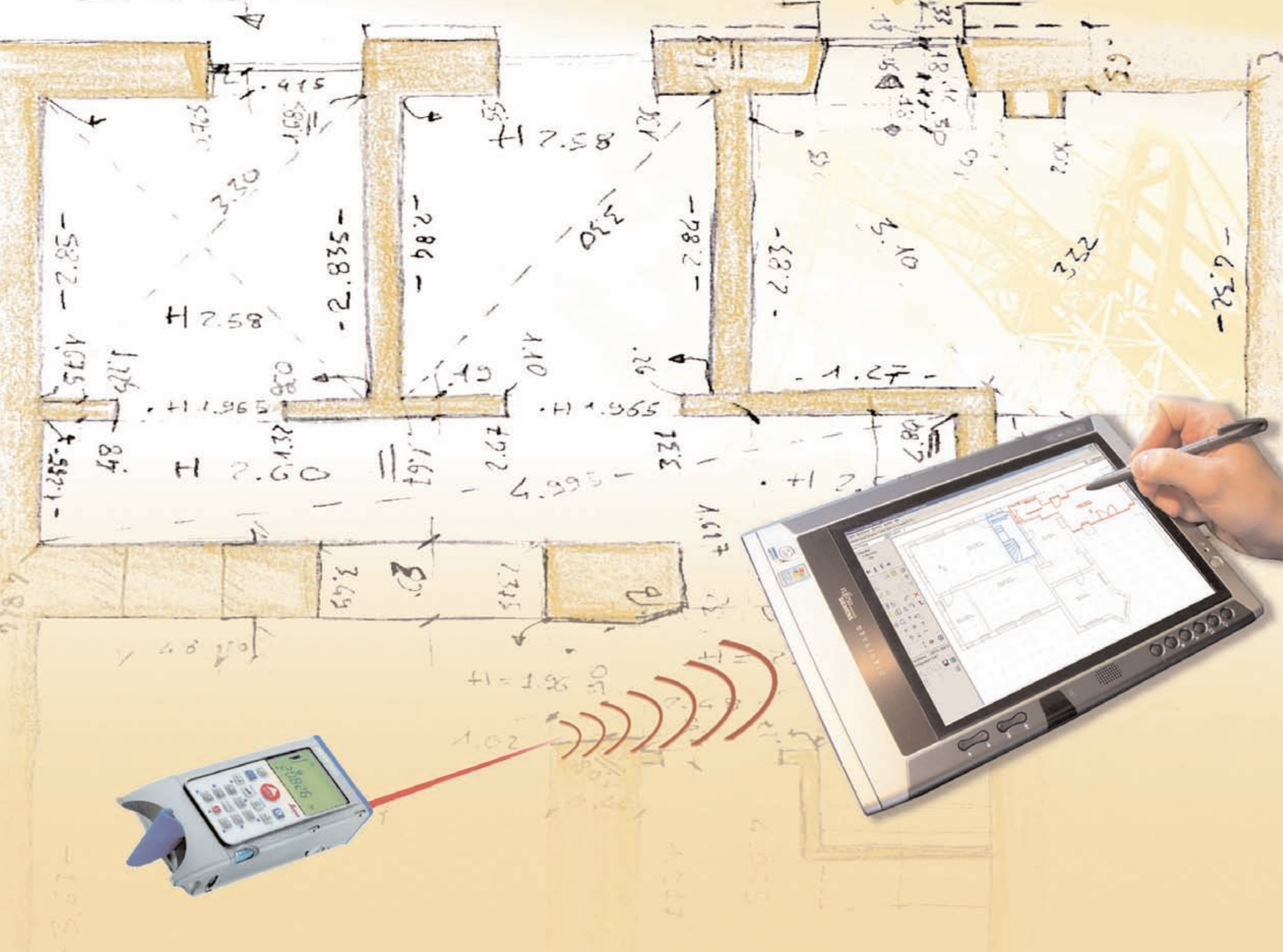


Once you have established there are no problems with the running of your fans and they are just noisy you could switch to a modern design with better bearings. They generally come in stock sizes 60mm, 80mm etc and a good source for these in the UK is www.overclockers.co.uk as they list the noise level for each model they sell. Likewise your CPU heat sink and fan design (generally integrated) could also be very noisy. If you have a dual CPU system your options are limited but for single (one or two cores) CPUs the Arctic Cooling range is quiet and very good value. Just make sure that you put a very thin and even heat transfer paste on the CPU when installing. These are also available from Overclockers.

The next stage in cooling is to use liquids commonly known as water cooling (not necessarily water!). Water cooling is generally used in specialist applications such as Cray supercomputers or for game players to get the fastest frames in certain games. This is basically a miniature domestic fridge piped to "heat blocks" attached to the hot components. Armari sells a liquid that is non-conductive and can be poured onto live circuits. I'm not suggesting that this is a solution for general workstations but Intel has adopted a similar technique by using heat pipes for its latest Xeon Processors. These have physical pipes filled with gas that takes the heat away to the cooling fins where the temperature drops and then drawn back to the hot area again.

Heat is one of the main factors for failures in computer components, when you sniff that electrical burning smell then it's already too late. If you suspect that your system can't survive the current heat wave I would shut it down and go down the pub for a long lunch! Anyway that's the excuse I'm using!

Robert Jamieson works for workstation graphics specialist, ATI. ***rjamieson@ati.com***



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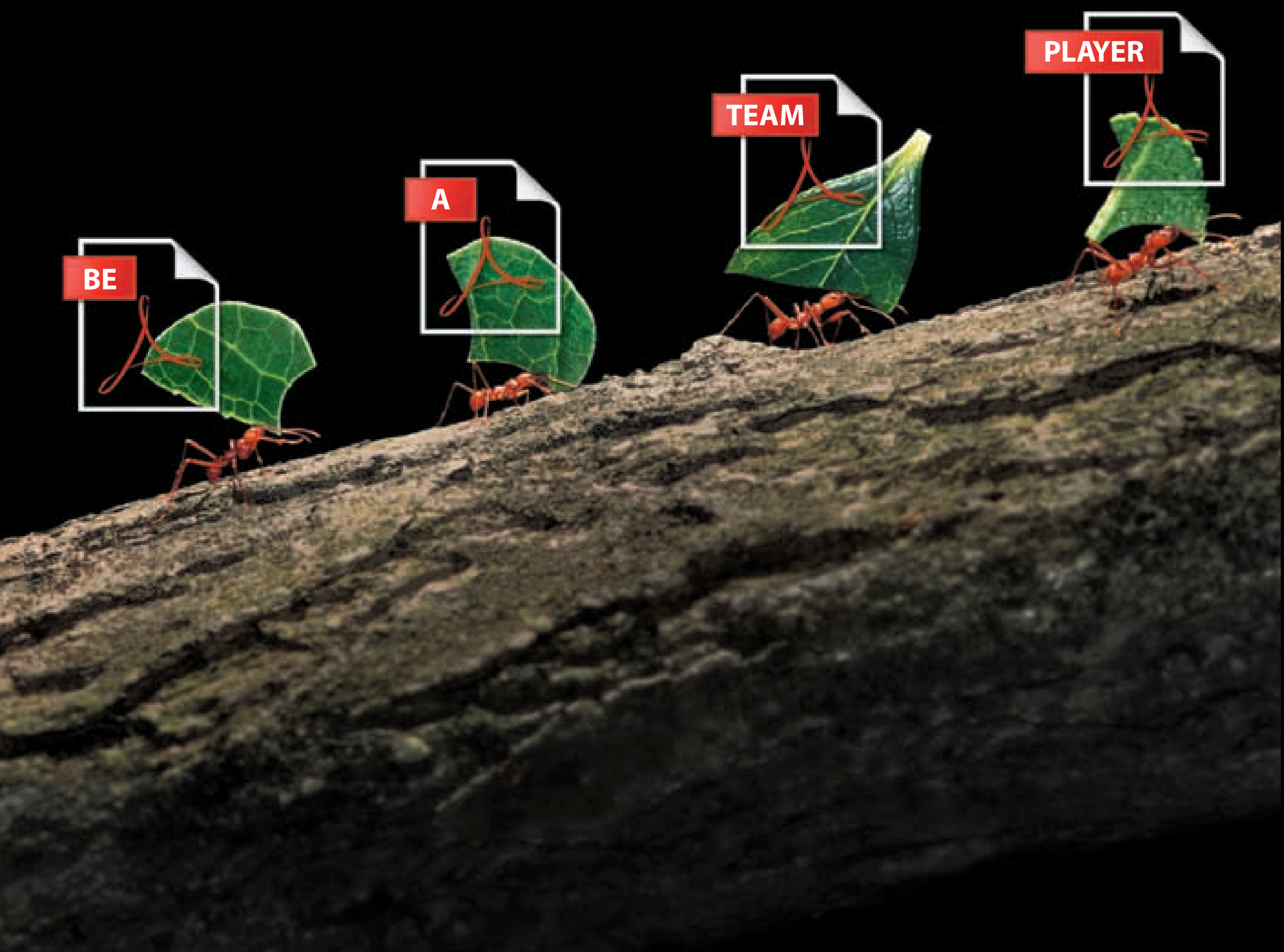
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